THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XI. No. 247—14th YEAR.] LONDON, APRIL 8, 1862. [Subscription per Ann. 15s. in Advance 18s Credit.] DOUBLE No. Price 1s.

CANNEL COAL.

RAMSAY'S NEWCASTLE CANNEL has become the principal Cannel Coal used in the Metropolis. Its joint products of gas of high illuminating power, and coke of good quality, make it one of the most economical coals known. The Crystal Palace was lighted from it in 1851, and the Post-office, and *Times* Office, are at present.

FIRE-CLAY RETORTS and PIPES.

FIRE-BRICKS (marked "RAMSAY") OF ALL DESCRIPTIONS.

G. H. RAMSAY, Broad-chare, Newcastle-on-Tyne.
Manufactory established in 1804.

LIMERICK Corporation Gas-Works. The Gas Committee of the above Works are in want of a second-hand STEAM-ENGINE, BOILER, and EXHAUSTER. The Engine to be 6-horse power, with all necessary pulleys for driving Exhauster, Pumps, &c. The Exhauster to pass 20,000 cubic feet of Gas per hour, and to be of Beale's patent.

Parties having the above for sale will please communicate with J. P. O'FARRELL, Manager, Corporation Gas-Works.

By order, J. CLANCHY, Secretary.
April 4, 1862.

STATION-METER FOR SALE.

A STATION-METER, made by the late SAMUEL CROSLEY, to be sold. It is in perfect working order, with Clock and Tell-Tale; capable of passing, by Maker's scale, 4500, and practically, 6000 cubic feet of gas per hour. The Connexions are 6-inch.

For further particulars, apply to Mr. J. O. N RUTTER, Gas-Works, Blackrock, BRIGHTON.

IRON TANK AND GASHOLDER FOR SALE.

THE Cardiff Gaslight and Coke COMPANY have for sale a GASHOLDER and CAST-IRON TANK, with Inlet and Outlet-Pipes, Columns, and Counterbalance Weights, complete, and in good condition. The Gasholder is 52 ft. diameter by 18 ft. deep, with a working capacity of about 38,200 cubic feet.

Any further particulars may be obtained upon application to Mr. BOWEN, Gas-Works, CARDIFF.

WANTED, GAS-WORKS TO PURCHASE OR LEASE.

THE County and General Gas CONSUMERS COMPANY (Limited) are desirous of purchasing or leasing GAS-WORKS on equitable terms.

Application to be made to the Engineer of the Company, Mr. H. P. STEPHENSON, 58, PALL MALL, S.W.

TO GAS COMPANIES.

ON SALE, by Private Treaty, at the Gas-Works, St. Helen's, Lancashire, FOUR DRY-LIME PURIFIERS, with Hydraulic Valve, Connecting-Pipes, Grids, &c.

The Purifiers are 6 ft. by 6 ft. 2 in., with Four Tiers of Grids. The Hydraulic Valve has 8-inch Connexions all complete, with Grids for the Lime.

The whole of the above are equal to new, and are being removed for the purpose of enlarging.

Also, a STATION-METER, capable of passing 7000 cubic feet per hour, with Bye-Pass, Clock, and Tell-tale.

Reference can be made to Messrs. WEST and GREGSON, Meter Manufacturers, OLDHAM.

Apply to Mr. WILLIAM PRITCHARD, Gas Office, ST. HELEN'S.
February 18, 1862.

READING Old Gas Company. To be sold cheap, 4 D-shaped New Iron RETORTS, 7 ft. 6 in. long, 15 × 13 in.

Also, Two Tons of BALANCE-WEIGHTS, in half-circles, 18-inch diameter.

For price and particulars, apply to JOHN KEELING, Engineer, BRIDGE STREET, READING.

SINGAPORE GAS COMPANY (LIMITED).—The Directors hereby give notice that no further Applications for SHARES in this Company will be received after Thursday, the 17th of April.

The Directors will then proceed to allot the Shares, and take immediate measures for the Construction of the Works.

Prospectuses and Forms of Application may be had at the Company's Office, or of the Company's Broker, Mr. FRANCIS BURNAND, County Chambers, 14, CORNHILL. By order, ROBERT KING, Secretary.
76, King William Street, E.C.,
April 5, 1862.

COWEN'S PATENT FIRE-CLAY RETORTS.

JOSEPH COWEN and CO.,
BLAYDON BURN, NEAR NEWCASTLE-ON-TYNE,

Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS RETORTS and OTHER OBJECTS in FIRE CLAY."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts in the United Kingdom; and orders for Fire-Clay Retorts of all shapes and dimensions, Fire Bricks, and every other article in Fire Clay, are promptly executed at their Works as above.

COWEN'S GARESFIELD COAL AND COKE.
Coal and Coke Office,
QUAY SIDE, NEWCASTLE-ON-TYNE.

FIRST PRIZE IN THE PARIS EXHIBITION.

JOHN RUSSELL AND CO.,
THE OLD TUBE WORKS,
CHURCH HILL, WEDNESBURY;
ALMA WORKS,
WALSALL, STAFFORDSHIRE;
and 69, UPPER THAMES STREET, LONDON,

Original Manufacturers of Wrought-Iron Gas Tubes and Holders of the present Patents; Inventors and First Makers of LAP-WELDED FLUES for Steam Boilers.

J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water, and the largest Orders may be executed in a few days.

Gun Metal, and all other kinds of Cocks, Stocks, Dies, and Taps, Galvanised Tubes, &c.

N.B. All Goods thoroughly Tested before sent out, and Warranted.

ANDERSON'S EXPERIMENTING LABORATORY
AND
GAS ENGINEERING OFFICES,
16, ADAM STREET, ADELPHI, W.C.
(Close to the Society of Arts.)

Mr. ANDERSON continues to Erect, or to supply the Drawings for his PATENT RETORT-SETTINGS. On this principle, three Ovens of Retorts are heated by one Coke and one Tar fire; and, for small Works, the principle is adapted to single Ovens in both cases, with a total absence of smoke, while the duration of the Retorts is from two to three years, and with great economy of fuel.

Mr. ANDERSON continues to supply his PATENT GAS-EXHAUSTER, together with Steam-Engines, &c., erected complete.

This is the most simple machine of the kind in use, being merely a double-action Pump, which any one can comprehend, and works for years without any repair.

Also, his PATENT FOUR-WAY VALVES. One of these valves does the work of three ordinary valves, when applied to Purifiers, Station-Meters, or other Gas Apparatus.

A workman cannot, by any possibility, make the mistake of shutting one passage without opening another; thus ensuring a constant flow of the gas.

All Racks, Pinions, Springs, and other delicate parts of ordinary valves, are in these valves abolished; the Connecting-pipes are also much simplified, and the cost reduced fully 30 per cent.

Also, his CONCENTRIC GOVERNOR, which stands in half the space of the ordinary Governor, and regulates the flow of Gas to the greatest nicety.

Mr. ANDERSON having five Gas-works on lease, besides being engineer to several others, has constant opportunities of perfecting his inventions before they are brought under public notice.

Mr. ANDERSON, in conjunction with Mr. STEVENS, of the Darlington Works, has recently erected and leased for a term of years, two Gas-Works of the Government, one at VICTORIA HOSPITAL, the other at the CAMP at ALDERSHOTT. At both places, the above designs are introduced, and cards to view may be had on application; as also, references to gentlemen who have used his apparatus for years.

Mr. ANDERSON may be consulted on all matters connected with the Manufacture of Gas, the Construction of new, or the reconstruction of old Works, Valuing the same, or obtaining parliamentary powers.

The Laboratory is being fitted up with apparatus for testing the chemical and photometrical properties of Coal-Gas, and also that of Meters, agreeably with the Act of Parliament. Gentlemen desirous of inquiring into such matters, are invited to pay a visit.

BLAYDON BURN AND LOW BENWELL FIRE-CLAY RETORT AND FIRE-BRICK WORKS, NEAR NEWCASTLE-ON-TYNE.

WILLIAM COCHRAN CARR begs most respectfully to thank the Metropolitan, Provincial, and Continental Gas Companies for their patronage for several years past, and to intimate that he has rebuilt and enlarged his extensive premises for the Manufacture of CLAY RETORTS; and that he is now prepared to execute the largest orders with punctuality and despatch. Orders for FIRE-CLAY RETORTS, of all shapes and sizes, FIRE-BRICKS, and all other Articles in Fire-Clay, executed on the shortest notice, and on the most reasonable terms.

London Agents:
JAMES LAWRIE & CO.,
63, OLD BROAD STREET, CITY, LONDON.

MR. PRESTON LUMB has removed to 42, PARLIAMENT STREET, WESTMINSTER, where he may be consulted on all matters relating to Gas Engineering.

London, March, 1862.

BEARDMORE'S HYDRAULIC, AND OTHER TABLES.

The Publishers beg to announce that this work, having been long out of print, has been entirely re-arranged, and the original Tables have been merged into a Treatise, entitled

A MANUAL OF HYDROLOGY.

This Book contains: DIVISION I.—Hydraulic, and other Tables, with descriptive matter, and many new tables; the whole placed in a concise form.

DIVISION II.—On Rivers and Flow; on percolation of water; on wells and springs. On the flow in sewers, and water supply, with description of the floods of many considerable rivers, with other characteristics appertaining to their hydraulic conditions.

DIVISION III.—On Tides, Tidal Rivers, Estuaries; containing the strictest details of the conditions assumed by the tides under the varied states of the bore, and of those places where the tidal wave vanishes, also showing the effect of improvements in many of the tidal rivers of this country. Explained by tidal diagrams, sections of rivers, co-tidal lines, plates elucidating channel tides, &c., &c.

DIVISION IV.—On Rainfall and Evaporation; containing the best experiments on evaporation in various climates, tables of rainfall under every variety of elevation, period and locality. These Tables include all parts of the British Isles, France, Germany, Italy, Russia, North America, Australia, and India.

The work consists of 400 pages, and there are 20 large Plates.

Will be issued on the 14th of April, price £2. 2s.

WATERLOW and SONS, 49, Parliament Street, Westminster; 24, Birchin Lane, and London Wall, LONDON

FOR SALE.—The following ENGINES, PUMPS, and other Machinery, now fixed at the Richmond Water-Works, viz.:—

ENGINE No. 1.

20-Horse-Power, Improved High-Pressure, Expansive Condensing BEAM-ENGINE. Bright parallel motion, Pump Connexions, and Ball-Governor, Vacuum, and Steam-Gauges complete.

Two 8-inch PLUNGER-PUMPS. Cases, Stuffing-Boxes, Glands, and Clack-Pieces, with about 20 feet of Suction, and Rising-Main to each. All in first-rate working order.

ENGINE No. 2.

20-Horse-Power, Low-Pressure, Condensing BEAM-ENGINE. Bright parallel motion, Ball-Governor, Vacuum, and Steam-Gauges complete.

Two 8-inch BUCKET-PUMPS. Working-Barrels, and Clack-Pieces, 160 feet of 9-inch Rising Main, and about 28 feet of Suction; Pumps-Rods and Connexions to Engine complete. All in good working order.

Also, Two 15-inch BUCKET-PUMPS. Working-Barrels and Clack-Pieces, 20 feet of Rising-Main, and 10 feet of Suction; Pump-Rods and Connexions to Engine complete.

These Pumps can be worked separately, or together, as they may be required.

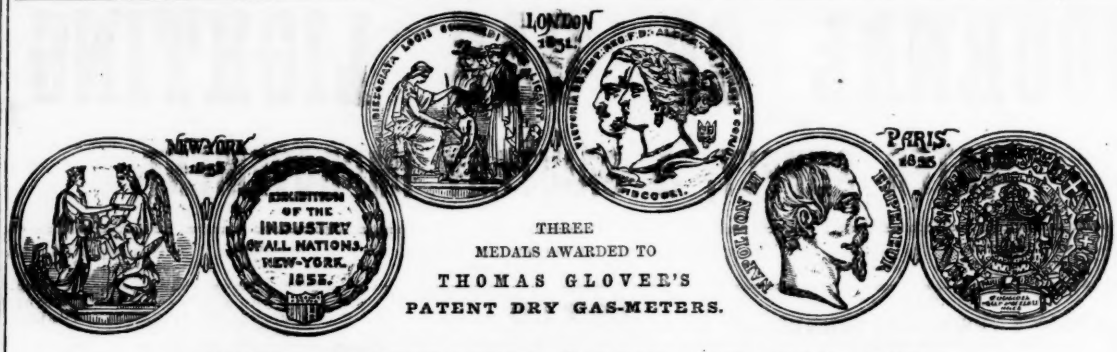
BOILERS.

Two Cornish BOILERS, connected to these Engines, to be worked separately, or together. One, 16 ft. long, 5½ ft. diameter; Glass Water-Gauges, Gauge-Cocks, and Blow-off Cocks, complete. The other, 14 ft. long, 5 ft. diameter; Glass Water-Gauge, Gauge-Cocks, and Blow-off Cocks, with complete sets of Fittings to each Boiler.

One Cast-Iron CISTERN, 30 ft. long, 18 ft. wide, and 4 ft. deep; will contain 12,960 gallons, can easily be separated for transport, and is in excellent condition.

The above to be sold, either together or separately, and can be seen at any time, and any further information obtained, by applying to Mr. BURGESS, on the Works, at RICHMOND.

JOURNAL OF GAS LIGHTING NEWSPAPER PENNY



THREE
MEDALS AWARDED TO
THOMAS GLOVER'S
PATENT DRY GAS-METERS.

LORD REDESDALE'S "SALE OF GAS ACT."

DRY METERS *VERSUS* WET METERS.

LONDON, February 25, 1861.

THOMAS GLOVER begs to call the attention of Gas Companies and others to a few *facts*, which, if duly considered, must lead to most important conclusions :—

1. That since THOMAS GLOVER commenced to manufacture his Patent Dry Gas-Meters (which is now upwards of 15 years), every Wet Meter Maker of any importance in England has been compelled to manufacture Dry Gas-Meters; and in the JOURNAL OF GAS LIGHTING, of date of 12th of February, 1861, Messrs. William Parkinson and Co., successors to the late Samuel Crossley, advertise that they "intend manufacturing *Dry* as well as" Wet Meters, and it is worthy of particular notice that they intend to do so "after 40 years experience in manufacturing Wet Gas-Meters of such a quality that has enabled them, as they say, to maintain a superiority over all other; and this, be it also particularly noticed, after they had advertised in the JOURNAL OF GAS LIGHTING, January 29, 1861, "their improved low-spouted Gas-Meter with new patent float arrangement, which entirely overcomes the difficulty experienced by ordinary Wet Meter."

2. That it is quite consistent with THOMAS GLOVER'S knowledge that Wet Gas-Meters, called "low-spouted" or "compensating Wet Meters," have already been proved to be incapable of continuous working or registration, and for this reason the manufacturers of these Meters have been induced to seek the repeal of Lord Redesdale's (righteous) Sale of Gas Act.

3. That every year the Patent Dry Gas-Meter manufactured by THOMAS GLOVER has risen in favour with Gas Companies and Gas Consumers, placing him in the proud position of being the largest manufacturer of Gas-Meters in the country.

THOMAS GLOVER guarantees his Patent Dry Gas-Meters to meet all the requirements of the "Sale of Gas Act," to give accurate and unvarying registration with steady lights; and, from their peculiar construction, cannot be tampered with, and may be fixed in open situations even above or below the level of the lights. They work with less pressure than Wet Meters, and are not affected by the most severe frost.

THOMAS GLOVER guarantees to uphold all Meters sold by him for 5 years free of expense to the purchaser, or for a trifling per centage per annum will contract with any Gas Company to uphold their Meters of his manufacture for a series of years; and, at the conclusion of such contract, to leave the Meters all in perfect working order.

N. B.—Agents in several parts of England are wanted. Apply by letter, or personally.

WILLIAM PARKINSON AND CO.

(SUCCESSORS TO SAMUEL CROSLEY),

PATENT WET AND DRY GAS-METER MANUFACTURERS, &c.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

PATENT IMPROVED WET METER.

W. P. and Co. invite especial attention to this Meter, which entirely overcomes the difficulty to which ordinary Wet Meters are subjected, owing to the short range of the Float, which is necessary, in order to meet the requirements of the Sale of Gas Act.

"It is well known that in Meters constructed so that the valve will close when the water is drawn off to such a point as to render them 3 per cent. slow the lights are liable to be extinguished by the closing of the valve by a sudden increase of pressure. To meet this difficulty, Mr. Pinchbeck has invented an ingenious and simple arrangement by which the action is reversed, and any such increase of pressure, in his Meter, raises the value instead of depressing it. The fact of the improvement having been adopted by Messrs. W. Parkinson and Co. is a sufficient guarantee that it practically and effectually remedies the inconvenience it is designed to meet."—JOURNAL OF GAS LIGHTING.

PATENT IMPROVED DRY METER,

Which W. P. and Co. pledge themselves to manufacture with the same quality of materials and workmanship as in their Wet Meter, thereby giving Gas Companies and others the advantage of procuring a first-rate Dry as well as a Wet Meter, which, hitherto, they have been unable to do.

STATION-METERS AND GOVERNORS,

Which can be seen at all the London Gas-Works. Also Liverpool, Manchester, Sheffield, Nottingham, Belfast, Glasgow, Birmingham, Dublin, Bristol, Leeds, Leicester, Brighton, Southampton, Sunderland, Wolverhampton, Bradford, Norwich, &c., &c.

TEST GASHOLDERS, EXPERIMENTAL METERS, EXHAUSTER REGULATORS,

MINUTE CLOCKS, PRESSURE GAUGES, PHOTOMETERS, PRESSURE REGISTERS, &c.

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NOTICES.

The subscription is 15s. per annum, if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, in July and January of each year. Post-Office orders must be made payable at the Charing-Cross Money-Order Office, to William H. Bennett, No. 42, Parliament Street, Westminster.

The next number will be published on Tuesday, April 22, and the subsequent numbers on each successive alternate Tuesday.

Stamped copies, when forwarded by post, must be folded so as to expose the stamp; they are otherwise liable to the full postage charge for letters.

This JOURNAL has been duly registered at the General Post Office for transmission abroad.

All Communications to be addressed to the Editor, No. 42, Parliament Street, Westminster; and orders for Advertisements to the Publisher, Mr. W. B. King, No. 11, Bolt Court, Fleet Street.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, APRIL 8, 1862.

Notes upon Passing Events.

THE Admiralty have, to use a coarse but expressive American phrase, been "knocked into a cocked hat," by the battle of the *Merrimac* and *Monitor*. Those officials who have minds capable of being convinced of anything, see the folly of the course pursued in naval construction not only for the last twenty years, but for the last seven, during which last period ten millions have been spent in building wooden ships, and three more in repairing them. It is a pity that Sir Howard Douglas, who so prided himself on having prevented Sir Robert Peel from building a fleet of iron ships, is not alive to see the utter foolishness of his last words. The Admiralty officials, who learned nothing from the Emperor of the French's iron batteries in the Russian war, and who long after continued making experiments *to prove* that there was nothing like wood—firing big guns at iron plates not much thicker than paper, are now silenced. A really able man like old Sir Howard Douglas was entitled to his last word, and excused, in consideration of his age and his past services, for his prejudices; but, it is really pitiable to see the feeble struggles with which the official defenders of the pro-timber fleet authorities are trying to let down their chiefs easy. The official *Globe* began by suggesting that if the *Cumberland* and the *Congress* had been swift screws, instead of sailing ships, the result might have been different. No doubt, it might. They might have run away. And a very satisfactory sight it would have been to have seen a whole fleet of British steamers flying before one American invulnerable, like a flock of sheep before a cur dog, or stopping to be set on fire by shells from a vessel that no shell could produce any effect on. We need not seek far for the inspiration of the *Globe*, for Sir Cornewall Lewis and Lord Clarence Paget—two really able men, who must know better—both talk the same stuff in the House of Commons. Fortunately, they only mean to cover their retreat from a foolish position, under a cloud of words. The Duke of Somerset, a few days later, was obliged to be more explicit, and his speech was far from satisfactory. If they do mean anything then the fate of Lord Palmerston's administration would turn on that reconstruction of the Admiralty, which is the one positive pimple of the critical *Saturday Review*.

Truly, we are a fortunate nation. Just before the Chancellor of the Exchequer produces, among other items of expense, the bill of costs for experiments of heavy artillery against iron plates—experiments which, whatever they may prove to the select few, do not do much to convince the multitude—our rivals and threateners, the Americans, perform a practical experiment for our benefit, which cannot be hidden or muddled in a see-saw report. We have more iron and coal, and more men and machinery for working iron, than any country in the world; plenty of money for any necessary purpose; and a defensive policy. The little *Monitor*, built in six weeks, for £60,000, solves the question of port, and coast, and colonial defences. It has shown how a battery, which is only fit to be moved round a coast, may be made stronger than any power of attack that we know of at present. And this is most important to a nation whose policy is "peace if possible." The *Scientific American* gives engravings of the rival invulnerable steamers, with descriptions, that of the *Monitor* being more complete than anything we have hitherto seen. The *Merrimac*—or, as she is now called, the *Virginia*—is, with the exception of her funnel, not unlike a whale floating on the water. Each side seems pierced for four guns, and she also seems to carry one or more at bows and stern. The *Merrimac* was partially burned and sunk when the Gosport Navy Yard was destroyed, to prevent its falling into the hands of the Confederates. She was a fine screw frigate, of 3200 tons, carrying 40 large guns. After the Confederates had raised her, they plated her with railroad rails, inclined at a sharp angle. This armour afforded efficient protection against heavy artillery at close quarters. She is said to be armed with 11-inch guns, and two 100-pounder Armstrong guns. The editor suggests that the statement as to the Armstrong guns must be a mistake. She has a sharp steel projection at the bow, for piercing the sides of vessels. The engraving of the *Monitor* gives the idea of a Thames barge, loaded to the water's edge, with sharp, instead of square ends. A small iron box, pierced with slits, covers the steersman's head. A circular pavilion or turret, covered at the top with an awning of canvass only, in the centre of the boat, holds the artillery. A sculler's outrigger does not expose more above the water-line than this *Monitor*. "The upper section is in the form of a flat-bottomed *scow* (river barge), with sharp ends and vertical sides, 5 feet deep, 174 feet long, and 41 feet 4 inches wide. The central portion of the bottom is cut out, for a length of 124 feet, and a width of 34 feet, to communicate with the lower section, which is attached to the bottom of the boat, and extends down with inclined sides to a depth of 7 feet 6 inches. The lower section is built of iron, the plates being half an inch in thickness. The upper section is built very strongly of wood and iron; the vertical sides being of solid oak, 30 inches in thickness, covered by one-inch rolled plates to the thickness of 6 inches. The propeller and rudder being under the projecting end of the upper section of the vessel, are securely protected from shot. The cylindrical revolving turret, in which the guns are placed, is formed of rolled one-inch iron plates, bolted together to the thickness of 8 inches. Its internal diameter is 20 feet, and it is 9 feet high. It rests at its lower edge on a smooth flat ring of composition metal; but, when in action, the principal part of its weight is sustained by a central shaft,

about which it revolves, a massive wedge being driven below the step of the shaft on such occasions to raise it, and thus cause it to bear up the turret. Two 11-inch guns are placed within the turret, in position precisely parallel with each other, on smooth ways or slides; a clamp being arranged upon the side for adjusting the friction and taking up the recoil in such distances as may be desired. The turret is pierced in different places with four holes for the insertion of telescopes; and, just outside the holes, reflectors are fixed to bend the ray of light, which comes in a direct parallel with the guns, through the axis of the telescope, which is crossed by a vertical thread of spider's web through the line of collimation. The sailing master takes his position in the turret, with his eye to the telescope, and his hand upon the wheel that governs the motion of the small engine, and turns the turret, so as to keep the guns always directed with absolute precision to the object against which the fire is directed. A scale is also arranged for adjusting the elevation of the guns with similar precision. In preparing for action, the awning over the turret is removed, and the square smoke-stacks, as well as shorter pipes through which air is drawn into the vessel, are taken down. The wheelhouse, in which the steersman stands, is made of iron bars, 9 inches by 12 inches, interlocked at the corner. The turret was opened at the top, because, when closed, the concussion of the guns was found to be unbearable." We do not understand how the interior of the turret is protected from the fall of a shell. The Federal Government wisely forbids the publication of a sectional view of the *Monitor*, which would perhaps explain this point. There are contradictory reports as to the condition of the crew while fighting in this iron box.

The annual report of the American commissioner of patents bears witness to the straits to which the Federal States are being reduced by the civil war. The receipts of the year have fallen off by nearly £30,000. The commissioner says, in the American language—it certainly is not English pure and undefiled—"The great inventive mind of the country has been attracted in another direction by the startling scenes of rebellion which have transpired." "A state of civil war has deprived this office of the patronage of the Slave States, the enterprise of the loyal States has been paralyzed, and the sale of patent rights, as an article of traffic, has, in a great measure, been abandoned." An advertisement in the *Scientific American*, invites the Federal inventors to seek in Europe compensation for the loss of the home market. The commissioner also relates how the loss of official income has compelled him to dismiss and reduce the salaries of his staff: he has dismissed five principal examiners, five assistant examiners, and five second-class assistant examiners, and dropped all the remaining officers to salaries one degree below their original position; as if a colonel became a major, a major a captain, and so on as to salary only, the duties remaining the same. Even the pay for copying has been reduced from 10 cents to 8 cents per 100 words. "A large number of labourers, watchmen, and attendants have also been dismissed. It seems, too, that while salaries have been reduced, the expenses of living have been increased, from the encampment of the army round Washington, and the stoppage of the supplies from Virginia. Then, again, the commissioner has been obliged, for want of funds, to give up printing, in full, the specifications and drawings of the patents issued. He earnestly begs for an allowance of 50,000 dollars to pay for the printing of the year. After referring to the scale of magnificence on which Great Britain is publishing the specifications and drawings of patents, he promises that, by the adoption of the photographic system of illustration, the American patent publications if continued, "would surpass, in practical value, those of Great Britain." Is this so? Or, is there any thing peculiarly favourable to photographic operations in the American climate? During the past year, 420 American patents were granted for inventions in the peaceful arts, and 58 for war implements. The register of copyright books at the patent office, affords an instance of the disjointed discipline of the Federal States. The unhappy commissioner complains that the district clerks refuse to do their duty, on the ground of insufficient pay, that there is no law to enforce obedience, and for eight years one clerk has refused to forward either records or copyrights. Thus, not more than two-thirds of the works which ought to be, are filed, or deposited with the commissioner of patents. This does not, however, affect us on this side of the water, being as we are excluded from copyright privileges.

Mr. Stuart Wortley, chairman, we believe, of the new Red Sea Telegraph Company, has been writing a very foolish letter to the *Times*, in answer to a Sir J. D. Hay, M.P., who had protested against the use of gutta-percha in such a climate as that of the Red Sea. Mr. Wortley has evidently not read the report of the Telegraph Committee, or, even if that was too tough for him, the articles on Long Sea Telegraphs, in the March numbers of "All the Year Round;" if he had, he would have found that, "until recently, gutta-percha was the only material used to insulate telegraph cables, although experience had shown that, even when most perfectly manufactured, it could not resist the heat of tropical climates. At a temperature of a little over 120° Fahr., gutta-percha is entirely spoiled." India-rubber has been so improved that all, or almost all, the defects which obstructed its previous use have been removed. It bears 200° temperature without loss of insulatory power; is of unlimited durability under water; and, therefore, it may be expected that india-rubber will come into use for those hot climates, where gutta-percha fails.

The agitation for getting up a guarantee for an Atlantic telegraph continues, but, so far, with small signs of success. The Labrador route is now being pushed into notice. The purchasers of the exclusive right of landing a cable in Newfoundland, are setting up their monopoly of what no wise man will repurchase, against the Icelandic privileges not yet sold, although granted, by the Danish Government to an American colonel. We look upon both these schemes as the mere bubbles of speculators, with a concession to sell. In reference to communication with Africa, Messrs. Glass and Elliott have been expressing their preference for long over short lengths of submarine cable—a very natural preference for manufacturers, who cannot make cables too long or too often. The Government had on hand a cable, intended to unite Rangoon and Singapore, which was found not to be suitable for that climate; so, not knowing exactly what to do with it, they laid it down between Malta and Tripoli; and from Tripoli, by way of Ben Ghazi, in two long lengths, to Alexandria. Some official, who knows nothing about submarine telegraphy, has been defending this route, on the ground that the division gave a valuable telegraph business from the intermediate stations. The fact is, that in 1860 Mr. F. C. Webb recommended, instead of the projects of a deep-sea line from Alexandria to Malta, a line from Malta to Tripoli, and from Tripoli by land, or in shallow water and short lengths, along the coast to Alexandria, thus ensuring easy, cheap, and rapid repairs. The Government adopted the route, but, hampered by the cable on hand, destroyed the chief merit of the plan in the execution: hence, the Ben Ghazi route. A telegraphic communication with the other side of the Atlantic is a matter, as we have before observed, of the utmost importance; but as much out of the range of a joint-stock company as the building of a *Warrior* or a fort. When the concessions have expired or the *concessionnaires* are tired out, something may be done as a national matter, not as a commercial speculation. To paraphrase Colonel Sibthorpe's favourite quotation—"*Timeo Danaos*," &c.—we have no confidence in the amiable offers of Yankee speculators.

Dr. Brady's Utilization of Sewage Committee has so far produced nothing new nor practical. The first witness was the Earl of Essex, who was, in 1857, chairman of a royal commission which was appointed to inquire into the same question as Dr. Brady's committee. The Earl takes the sewage of the little town of Watford to irrigate his land, thus conferring a substantial benefit on his neighbours, by saving their little river from pollution. His lordship began, he says, with a mistake, and underpiped 210 acres: he has since discovered that the sewage of Watford will not irrigate more than 60 to 80 acres. It is worth notice that every one, since the successful operations at Edinburgh, who meddles with either liquid manure or sewage, begins by making a serious mistake—all the information in the celebrated Blue Book of the Board of Health proves delusive; Mr. Chadwick's personal advice only leads to loss, if not to ruin. So it was with Mr. Kennedy and Mr. Telper, in Scotland; so it was with Mr. Chamberlain, in Norfolk, who acted under Alderman Mechi's instructions, and whose pipes now make pillars to the feeding-sheds of Mr. Hudson, of Castle Acre; so it was at Rugby, where one tenant, Mr. S. Bury Congreve, a real farmer, found sewage manure vanity and vexation of spirit, and another, Mr. Campbell—a gentleman amateur—as he told the Society of Arts—has given up pipes in favour of

the old system of open channels; so it was, and is at the French model sewage farm of Vaujours, to the formation of which Mr. Chadwick gave all he knew and all he hoped in the way of advice, and which has ended, as we have before related in detail, in loss of capital and loss on nearly every crop. On Italian rye-grass the sewage obtained from Watford close by, pays well, and that is the point on which attention should be fixed. The Earl of Essex tried an experiment on 4 acres of wheat; to one-half he applied no manure, to the other, before sowing, he applied sewage, and obtained a profit on the lot manured with sewage, of £2. 7s. 6d. an acre. But, his single experiment proves nothing—season has so much to do with crops; besides, guano, or other manure, at half the cost of the sewage, should have been tried with the other plot. At any rate, the result is contrary to the experience in Lombardy, where sewage irrigation is not applied to cereals; to experience at Rugby, and every other place of which there is any trustworthy record. The Earl of Essex is an honest witness, and his experience is worth more than his opinions. He speaks of "land suitable for sewage, *that is tolerably porous*," an essential point if sewage is not to be a nuisance. Lord Essex applies his to 10 acres of Italian rye-grass and 35 acres of meadow grass. "The rest is applied to roots." His Lordship does not say how it applied to roots, or whether in lieu of all other manure. It is well known that Alderman Mechi's attempts to grow roots without farm-yard manure and superphosphates, and with liquid manure alone, failed utterly, and that he had to learn from an unscientific neighbour how to grow good root crops. The distance from Watford to the Earl's farm is only a quarter of a mile. In that distance there is not time for injurious oxidation to take place. Lord Essex put the cost per acre of the sewage he applied to wheat, at 14s. per acre, which is rather more than the price of guano. An excellent wheat manure, composed of guano and superphosphates, may be purchased for £8. 8s. a ton. This is more portable, more easily stored, more cheaply applied, and, at a cwt. to an acre, cheaper than sewage. Lord Essex put on 6000 tons of sewage per acre which he calculates to cost him 1d. per ton on an average. That is £25 per acre for artificial manure; an enormous sum considering that an average of 25s. per acre is found sufficient by the best and most successful farmers in England and Scotland. We altogether doubt the Earl's profits; and, if he knows whether he is farming to a profit or loss, he is an exception among noblemen. But, nevertheless, he puts the matter in a right point of view, except where he talks of sewage and guano having "pretty much the same ingredients," for guano contains about 17 per cent. of ammonia—the most valuable source of fertility—and sewage, in its best state, not 1 per cent. Yet, it would be a fine thing if, near every town, patriotic landowners could be found to save the rivers and brooks pure, and feed the land with sewage.

Dr. Angus Smith, the next witness, is quite right in treating liquid sewage in a sanitary point of view. His theory is a disinfecting agent to be applied in the sewers—carbolic acid or creosote. "The organic matter in sewage begins to be oxidized immediately on its escape from the sewer; therefore, it is a substance that will not preserve long; it must be used immediately. Whenever the temperature is above 54°, the oxidation is intensely rapid." The chairman asked, "Are you aware that the sewage of London has been valued by Professor Hofmann at 2d. per ton?" to which Dr. A. Smith replied, as was expected, that the professor made it worth something like £1,000,000—the answer wanted. But the question and answer were altogether a deception. Professor Hofmann never said that the sewage of London was commercially worth anything—he has lately regretted that it is not; he only said that, theoretically, the ammonia in the London sewage would be worth £1,500,000, if you could collect it. On the same principle, the cod-fish off Dogger Bank might be estimated and valued. All these scientific estimates lead away from the real point—the getting rid of the sewage in such a manner that it will do the most good, and the least possible harm, and that can only be done by laying it on porous land, and growing artificial or natural grass, where such an operation is practicable. But it is childish to compare London and Watford. Sewage is not found worth buying at Watford or Rugby; all the value is expended in the cost of distribution. It cannot be got rid of without loss at Croydon. What can London sewage be worth, after travelling the miles it must travel to reach country air, and farmers who will take it? If the committee can find one responsible man prepared to take one-tenth of the supply of London, at a farthing a ton, they will be able to report something useful; but, what is the use of hammering away at the value of an article which no one will purchase?

How very different has been the progress of artificial manures! The first commercial cargo of Peruvian guano arrived about twenty-one years ago; about the same time, the manufacture of superphosphate, by adding sulphuric acid to bones, commenced; and, ten years afterwards, a Scotch farmers club reported that there were few farmers in the Vale of Annan who did not use two cwt. of guano at £12 per ton to grow turnips, with 15 yards of farm-yard dung. At the present day, 23s. an acre of guano, nitrate of soda, and superphosphate mixed, is a usual expense, beside farm-yard dung, for potatoes, turnips, and mangolds in Scotland. But, in Norfolk, where the land is much poorer, Mr. Hudson, of Castle Acre, spends £2. 18s. 8d. on manure, including home-made, on wurzel; £1 on turnips or swedes; £1. 9s. 6d. for wheat; and £1. 14s. 6d. for barley after wheat; and his may be taken as the general practice of the majority of West Norfolk, and other light-land farmers. The quantity and value of artificial manures consumed proves how extensively they are used. Of guano, bone-dust, superphosphate, nitrate of soda, sulphate of ammonia, and other substances of similar character, there are yearly consumed 491,000 tons of the value of £4,650,000, beside some 60 million tons of farm-yard manure. But this 60 million tons is not the mere produce of home-grown hay, straw, corn, peas, or beans, but its fertilizing value is increased by artificial food, estimated, taking linseed and linseed-cake, 300,000 tons, to have cost our farmers, in 1861, three millions sterling. The increase in the use of artificial manures has been, during the last twenty years, at the average rate, £200,000 a year—this increase being, of course, every year more rapid and extensive. With such statistics as these before us, it would be absurd to imagine for one moment that it is the dulness of the farmers that retards the profitable application of sewage to land. Farmers buy freely what will pay, and what will work in with the ordinary course of agriculture; but they naturally decline to purchase at a high price, or any price, a liquid which will cost money, whether they want it or not, and cannot be stored or sold again like a bag of artificial manure. On these facts, let the Metropolitan Board ponder, while Dr. Brady prepares his report, at public expense, for the butter-shops. But, if Dr. Brady wants real evidence, let him call the late and present tenants of the Rugby farms, Mr. Congreve of Harborough Magna, and Mr. Campbell of Rugby. We defer for the present our comments on the other witnesses.

At a recent discussion at the Royal Agricultural Society, on the proper mode of treatment of agricultural steam-boilers, it was stated that the steam-power in use in agricultural districts was equal to 40,000 horse-power, without reference to steam cultivation, which, scarcely introduced two years, is daily extending.

The superficial and unphilosophical education of the men of what is called the "Manchester School," was illustrated, last month, at the Society of Arts, by Mr. H. Ashworth, in a paper on "Our Colonies, and their Cost"—the object being apparently to show that we were better without colonies. In order to make this out, military ports like Malta, Gibraltar, and the West India Islands, ruined by an inevitable change of trade and system, were muddled up with the Australian and the American colonies. In the first place, the value of colonies, dependencies, and military ports, cannot be usefully considered in a lump; each must be examined separately. It is a deception to talk of Corfu, or Malta, or Gibraltar, as a colony—it only confuses an important question. It may be wise policy to give up one to Spain; another to Greece, until France or Russia takes it; and the third to Italy or France; but these are political and military, not commercial and colonial questions. St. Helena is not of much, if any, value now; but it was a valuable half-way port once, and a great nation cannot economically dismiss a useless dependency as some people discharge a worn-out servant. When we consider the condition of real colonies, where men of European race can live and thrive, we must look at the policy of colonization as a whole. We cannot pick out the plums, and say, "We will only have the plums." If the policy of Mr. Ashworth's school had prevailed years ago, we should never have had customers growing up in Australia, sending us wool, and digging up gold to buy our manufactures; we should never have seen, in South Africa, fine-woolled sheep superseding ante-

lopes, and driving lions into the interior. We have no right to assume that we should have been as strong as we are if the poor, and the discontented of the working classes, had not had lands of promise beyond the sea to resort to. It is well to count carefully, and to individualize and weigh the value of each possession, to review from time to time for the purpose of cutting down useless expenses; but, to treat our various possessions simply as profitable and unprofitable customers, would be to destroy the whole credit of the nation. For what the French call *prestige* is credit to a commonwealth. It is possible to pay too much for appearances, but nations, as well as banks and insurance offices, must pay something. One great source of cost in colonies is our love of meddling. The humane, ignorant, and bigoted Aborigines Protection Societies have cost this country millions at the Cape. New South Wales has cost a great deal of money, but, then, it saved gaols, not to speak of a great deal of hanging, and New South Wales is the direct parent of Victoria and Queensland, which have given much and cost nothing, while South Australia, once a very costly crotchet, has long and many times repaid in meal and malt, all the Imperial Government expended on it. These great successes must be taken with such losses as Western Australia—such mistakes as the Falkland Island Settlement. It may be hoped that the modern system of naval defences will enable us to recall many scattered garrisons, and allow many costly fortresses to crumble to dust, or to be buried under tropical vegetation—that iron and steam may supersede the costly British soldier in many a tropical dependency. Mr. Ashworth's school would have given up Vancouver's Island to the Americans, the last and wealthiest of our colonized possessions!

THE METROPOLIS LOCAL MANAGEMENT ACTS AMENDMENT BILL.

Since our previous remarks on the subject of the Bill introduced by the Metropolitan Board for the supposed amendment of its Act of incorporation, much discussion has taken place, both in the Board itself, and in the public at large, with respect to the present composition and the future prospects of that body. The most overt expression of the opinions prevailing in the matter seem to be those contained in Mr. Ayrton's "clauses to be proposed in committee" on the Bill; in the "objections to the clauses so proposed to be introduced;" and in the attacks upon the Board by Mr. Locke and Sir J. Shelley. In none of these instances are the questions really involved discussed in a broad, philosophical manner; but it is a good sign when such abstract questions are discussed at all; and, as consistent advocates of the principle of local self-government, it behoves us to keep the subject before the public as much as lies in our power.

Mr. Ayrton, it must be observed *in limine*, is, unfortunately, about the very worst man in the House of Commons upon whom the task of reforming the Metropolitan Board of Works could have devolved. He is personally unpopular on account of his disagreeable manner, and of the captious spirit with which he treats everything he undertakes. Such a man is a good enemy; and the Metropolitan Board may congratulate itself on being attacked by him. Neither Mr. Locke nor Sir J. Shelley enjoys a much more enviable position in public estimation than Mr. Ayrton; and, if the Board had no other "threateners" than these, it is possible that "its life might be long;" especially as Sir J. Shelley is, rightly or wrongly, suspected of seeking to supplant Mr. Thwaites, and is, therefore, suspected of being an interested party in the quarrel he seeks to raise. But the deficiencies of the present opponents of the Board do not blind the public in general to the real merits of the case; they may cause some delay in the application of a remedy, and so prolong, for a time, the existence of a state of things which is day by day becoming more distasteful, and more unsatisfactory. The composition of the Metropolitan Board, and its operations hitherto, have, in fact, so roused the contempt and dislike of the ratepayers, that a change in its composition is, sooner or later, inevitable; and it is on this account that the discussion of the principles to be adopted for that reform must be conducted, without reference to personal considerations affecting either the advocates for or against the Board as at present organized.

Nevertheless, the "objection" raised by the writer of the document issued by the Board to the "form" of Mr. Ayrton's amendment is a very valid one. The debate upon the principle of the Bill, and any amendment likely to affect that principle, or the composition of the Board itself, ought to have been taken before the second reading, according to all the forms of the House of Commons. It is always understood that the changes in a Bill introduced in committee only affect matters of detail; and, when a Bill has passed its second reading, the members of the Legislature, who have no direct interest in the subject it particularly deals with, cease to watch its progress. Now, the scope of Mr. Ayrton's amendments, badly expressed as they are, is clearly meant to affect the system of election to the Board; and, therefore, they should have been made the subject of discussion before the second reading; or, Mr. Ayrton should have contented himself with opposing the report of the committee, or the third reading, if he had felt that he had been deprived of a fair chance of discussion during the previous progress of the Bill. There is somewhat of trickery in this attempt to introduce in committee clauses which would totally change the nature of the Bill on which they are proposed to be grafted; and it is to be hoped that the Legislature will at least consult its own dignity enough to avoid the introduction of so objectionable a course of proceeding.

Then, again, Mr. Ayrton has proved his utter incapacity of dealing with questions of political importance, by omitting to define the constituencies to which he proposes to intrust the election of the members of the Metropolitan Board, increased in numbers, as he provides in his first and second clauses. No doubt it may be inferred, from the tenour of the clauses, that the constituency of the new Board is meant to be the same as that of the ordinary vestries; but this is not expressed distinctly, nor on the face of the clauses is there anything to show by whom the elections are to be made. In the case of the City, too, Mr. Ayrton would seem to retain the principle of the election in the second degree, which now renders the organization of the Metropolitan Board so objectionable; for he proposes that the mayor (in courtesy, he should have said the *Lord* Mayor), aldermen, and commons (he means the Common Council), should elect their delegates to the Metropolitan Board—giving them six members, instead of three, as at present. The increase of the numbers of the whole Board, Mr. Ayrton suggests, can hardly be considered an advantage; for, in such bodies, the authority and reputation of the members are of more importance than their numbers, and, hitherto, no inconvenience has been felt from the numerical composition of the Board; and, indeed, the scheme of delegating the powers, granted by Sir B. Hall's Act to the whole body for carrying out the intercepting sewers, and now proposed by Mr. Ayrton to be intrusted to a committee of twenty-four, would seem to show that he himself is aware that his parochial Parliament would be too unwieldy for administrative purposes. Mr. Ayrton, moreover, proposes to change that part of the present Act which provides that committees named under its powers shall be responsible to the Boards which nominate them; or, more strictly speaking, that they shall report to their constituents, who alone are entitled to order the execution of their recommendations. This Mr. Ayrton seeks to modify; and he proposes that the Boards should instruct the committees they may appoint, and that the latter shall at once carry out the decisions at which they may arrive, without any necessity for reference to their constituents. Evidently, Mr. Ayrton knows little of the working of representative institutions!

The advocates of the existing Board would have easy work, were the gentlemen so often named above their only opponent; and the objections to his clauses would suffice, no doubt, to insure their rejection, were he alone concerned. But, in the name of the public, we protest against the doctrine that, because there has been no clamour for a radical change in the constitution of the Board, therefore, such a change is neither desired nor desirable; and we are strongly inclined to dissent from the inference that the writer of these "objections" draws from the absence of such clamour, to the effect that the Board "has not proved its incapacity, or is not likely to have new duties imposed on it." From the text of these objections, it seems that the whole business of the Board hitherto has consisted in carrying out the main drainage scheme and the new street in Southwark; but, really, the merit of devising the first is due to Messrs. F. Forster, Bazalgette, Haywood, Bidder, and Hawksley; the merit of devising the second is due to Messrs. Marrable and Bazalgette; and the execution of both necessarily comes within the attributions of the professional advisers of the Board, to whom all the blame or all the credit of the works is justly due. It is mere nonsense to say that

these works "have been carried on in a way to receive the confidence of the public;" because the question at issue is, not whether the public has confidence in the works, but whether it has confidence in the Board; and, whatever Mr. Thwaites and his friends may say, it is but too well known that the latter does not exist. The sewerage and the new street works have been well done thus far, and they will, no doubt, continue to be well done; but the nominations of district surveyors, the carrying out of the meter-testing, the very character of the debates in the Metropolitan Board, have begun to rouse a feeling of dissatisfaction in the public mind, which will compel a change of this abortive attempt at municipal organization at some early period, even if Mr. Ayrton's amendments be now consigned to the oblivion they merit. In the fierce struggle of business life in London, men rarely have time to occupy themselves with the conduct of minor public business; and it is notorious that we suffer ourselves to be taxed and plundered by vestry cliques, with exemplary patience. The Metropolitan Board of Works was presented by the press, and by its own authors, as the remedy for all the ills of the old parochial system in matters connected with our ædility, as the word was understood in the latter days of the Roman Empire. No perceptible change has, however, yet been made, excepting, perhaps, that some patronage has been transferred from the bench of magistrates to the vestry authorities; and Mr. Thwaites may rest assured that the day of reckoning for the errors—of omission quite as much as of commission—by his Board, is rapidly arriving.

It is a good joke to find the authors of the "objections," who, we may conclude, were directly prompted by Mr. Thwaites himself, defending the life presidency of the Metropolitan Board, on the score "of the necessity for a permanent head of an executive body, to preserve official traditions [red tape], to advise in doubtful cases [then why have professional advisers?], and to recall attention to previous proceedings!" Mr. Thwaites began life as a rather violent radical, and his speech on the occasion of the introduction of Sir B. Hall's celebrated Act dealt in all the ordinary parochial eloquence about "its centralizing character, and the great effect of centralization being to drink up the very last drops of liberty." In those days, he was an advocate for municipal corporations, in opposition to close vestries, and he must have known that the mayors and executive councils of all municipal bodies in England are subject to periodical re-election. No doubt, "the case is altered" when he is the person to whom the principle is to be applied, and "the discomfort of a contested election," must inspire him with the orthodox antipathy holders of well retributed positions feel to that process. Yet, "experience and precedent abundantly justify the necessity" for such re-election, and even the instances cited by Mr. Thwaites in favour of his own exemption from that "discomfort," prove against his position. For, in the first place, both the Speaker and the Chairman of Committees of the House of Commons, are subject to re-election upon a dissolution; and the Chairman of Committees of the House of Lords exercises functions which are purely judicial, but in no wise executive. The danger of making the presidency of the Metropolitan Board a lifelong post is, indeed, precisely on account of its executive character; and it would be at any time absurd to make an officer, however elevated his rank might be, independent of the persons who employed him. If Mr. Thwaites were really sincere in his former love for municipal institutions, he ought to have been the first to have admitted the illogical and inconsistent character of his present positions. It is unfortunate that the discussion of this important question should thus almost compulsorily be brought back to a personal one; but, Mr. Thwaites has so deliberately put himself forward, that he must expect the observations he himself provokes.

It is rumoured that, in high quarters, the dissatisfaction with the existing constitution of the Metropolitan Board of Works is quite as great as it is amongst the thinking classes of the ratepayers; and that a measure is contemplated for the express purpose of creating a municipal corporation for the whole of the metropolis. Such a measure would be very desirable; for there is still far too great a subdivision of powers in matters connected with the roads, sewers, watercourses, the services for the supply of water and of gas, the telegraphs, fire-police, public vehicles, places of amusement and refreshment, the bridges, river, and the countless other requirements of a highly civilized society. But, to succeed, a municipality of this description must be a faithful reflex of the wants and of the intellect of the population it is supposed to represent; and it must be brought frequently, and directly, in contact with its constituents. The writers of the "objections," seem to regard this contact between the representors and the represented with dread, and compare its probable cost and anxiety with "that for an M.P."—as they somewhat curtly express themselves. But, in the first place, it may be asked, whether, in a properly constituted municipality for London, there would not be nearly as much credit in sitting in the local Parliament, as there would be in sitting in the Imperial Parliament? As we said before Arago, Dumas, Horace Say, Delessert, &c., did not think the "discomfort" of a contested election for the Municipal Council of Paris sufficient to keep them from the lists; and, if our municipal constituency were only what it ought to be, we should, in all probability, find the same class of men take part in municipal affairs here. It is the character of the vestry constituencies which keeps our most respectable men aloof from local governing bodies; and, the first thing to be done, in order to cure this serious evil, is to raise the tone of the electors. At the present day, it would be idle to talk of limiting the suffrage, and the only method of effecting the desired object would be, we believe, to make the attributions of the new municipality so practically important as to render it an honour to wield them; for, in that case, a seat in the corporation would become an object of ambition to men of character and position, and, we may be sure, that in the end they will be the persons preferred by the electors. As to "the fatigue and cost of an election," if respectable men will not incur them, they deserve to be robbed by the small local cliques, which the Bermondsey agitators of former years now so magnificently scorn.

If carried out honestly, we believe then, that a municipal corporation for London, armed with great power and influence, and intrusted with important duties, would be a great improvement on the assemblage of vestry delegates, who now are, by courtesy, supposed to constitute the Metropolitan Board. Unfortunately, the same rumour which induces us to hope that one portion of the reform we have always advocated may be effected, causes us to fear that the new project may be converted into the means of creating a place for one of "our heaven-born rulers," of quite as objectionable a character as the place of paid chairman for life under the present system—perhaps with the disadvantage of its being appropriated to some unbusinesslike, incapable cadet of a great house. Forewarned is to be forearmed. The mere fact that projects, such as have been above hinted at, are currently said to be entertained, argues that the defects of the present system are beginning to be seriously felt; and, whatever may be the fate of the Bill now before the House of Commons, the whole question must be examined again, and seriously, before long. It will be the fault of the London public if the juggle formerly played upon them be repeated; and they will only have themselves to blame if they accept anything short of a return to the real principles of representative government in their own local affairs. The election of their representatives must be direct; all the officers of their representatives must be removable, and directly responsible to the authorities who employ them. If these conditions be faithfully observed, the wider the constituency, perhaps, the better, in spite of the sad failures of democracy in some surrounding countries. The tendency of our age towards the adoption of extreme democracy is so decided, that universal suffrage seems to be the inevitable solution of all questions connected with the organization of representation, and we ourselves are strongly inclined to believe that the labouring classes, who are now practically excluded from the franchise, are both more honest, and more enlightened, than the small shopkeeper class, that now possesses such influence, especially in municipal elections. But, whether the future municipality for this "huge department covered with houses," be elected by an open or by a limited franchise, it must be be made virtually sovereign and independent, within the limits of its own attributions; and, in the arrangement of the details of its administrative organization, the *doctrinaire* notions of election in the second degree, of partial re-elections, and of paid chairmen nominated for life, must be set aside, and a return made to the honester municipal system of our ancestors. To secure this result, it would be necessary, before and above all things, that the question be examined in a broad, philosophical spirit. In the present temper of our Legislature, this can hardly be expected; and "amendments" and "objections" are all the inhabitants of

this ungoverned metropolis are likely to have for their comfort. Fortunately, Englishmen have a faculty for governing themselves, and the practical evil of our defective municipal organization does not yet make itself very painfully felt; but the town is extending still so marvellously, and the wants of our civilization are becoming so complicated, that order must soon be introduced into this chaos; and it behoves us all to inquire how this end can be obtained in the most satisfactory and permanent manner. Hitherto the discussions, with respect to the constitution of the Metropolitan Board, have not been approached in the proper spirit; for they have turned, and still turn, solely upon questions of detail and of men. No good results can, however, be obtained, unless they are removed from this narrow sphere, and are made to bear upon the great questions of principle involved.

As to Mr. Ayrton's amendments, and Mr. Thwaites's objections, they may occupy a few parochial politicians; but they cannot materially affect the great problem of the municipal organization of this metropolis, and, in a few weeks, both will alike be forgotten. In the meantime, the Bill for the Thames embankment is being urged forward, and there is no public authority yet in existence to whom the execution of the requisite works can safely be intrusted.

Circular to Gas Companies.

The hot haste with which the Government were hurrying forward the Parochial Assessments Bill, has been checked by the strong opposition that has been raised against it. The proposition to increase the burthen of taxation on house and manufacturing properties in England, by assessing them at the rack-rent, on an estimate of the average annual value for seven years, without any deduction for insurance, repairs, or other expenses necessary to maintain them in their actual state, was, indeed, so unjust to the holders of such property as to call forth remonstrances from all directions; and the Government have been induced to pause before proceeding further in the matter. The select committee have not met since our last number was published, and the numerous and influential petitions that have, in the meantime, been presented to the House of Commons against the Bill from railway, gas, and water companies, afford such evidence of the feelings entertained on the subject by those bodies that they cannot fail to make a powerful impression on the committee when they re-assemble. We must, however, impress on all who are interested in the removal of the obnoxious clauses from the Bill the importance of not relaxing their efforts until those clauses are withdrawn, and the measure is so amended as to secure an equitable assessment of their properties.

The objections to the Bill, and to the existing system of assessment, are very forcibly presented in the form of petition printed in our last, and which has been adopted by many of the companies petitioning against the Bill. Those objections may be thus summed up:—First, that the rule of rating which has long prevailed in England, and which the Bill makes more oppressive, was established, before the creation of the enormous property now vested in gas-works, for the assessment of property utterly different, and, when applied to such property as gas-works, it is attended with anomalies and doubts, productive of perpetual litigation. Second, that the judges have declared that the existing rule of rating is inapplicable to gas-works, and that the Legislature ought to grant some relief. Third, that while other properties, including manufactories, are rated on the annual value of the hereditaments only, gas-works, and the land occupied by the main-pipes, are rated practically on an estimate of the net revenue of the undertakings. Fourth, that gas companies contribute an undue proportion to the whole amount of rates levied, although their undertakings add little to the expenditure for which the rate is made, and increase largely the value of the property in the parish. Fifth, that the proposed mode of making the assessments of a gas-work, on the estimate of the yearly rent, on a lease for seven years, is oppressive and unfair, as not only would the chattels and stock in trade be assessed, but, also the present and prospective profits of the undertaking. Sixth, that as a large portion of the property of a gas company consists of machinery and apparatus which rapidly decay, it is unjust to assess such property at the rack-rent, without allowing for the expenses necessary to keep it in repair. Seventh, that expectation of amendment in the law of rating of similar property was held out by a committee of the House of Commons in 1842; but, that if the present Bill were to pass, the hands of the assessing body would be strengthened, and, as it contains no provision for removing existing anomalies, the system of assessment now complained of would be tacitly confirmed and its evils perpetuated. The petition concludes by earnestly representing "the propriety of inquiring into the incidence of a burthen unjustly weighing upon undertakings which have added vastly to the comfort and convenience of the public, and the general prosperity of the country."

The Highways Bill has been considerably modified by the select committee to which it was referred. All the words have been struck out of the 19th clause of the original Bill, by which the objectionable power would have been conferred on Highway Boards of altering the directions and the levels of roads, according to their notions of public convenience, without regard to the interests of gas or water companies. The duties of the Boards are limited, in the amended clause, to the maintenance of the roads in good repair, for which purpose the same power is given to them as is now exercised by the surveyor of each parish.

An important public Bill, "to make more effectual provision for regulating the police of towns and populous places in Scotland, and for lighting, cleansing, paving, draining, supplying water to, and improving the same, and also for promoting the public health thereof," was introduced by the Government on the 21st ult., was read a second time on the 4th inst., and is to be considered in a committee of the whole House on the 8th of May. The Bill, which contains 438 clauses and occupies 141 pages, may be considered as an attempt to introduce into Scotland the principles of the Public Health Act and the Local Government Act of England. The Act is not intended to be compulsory in its adoption; and it may be adopted, either wholly or only partially, by resolutions of the magistrates or existing police commissioners, or by a majority of householders. The commissioners who are to carry the Act into operation in certain royal and parliamentary burghs are the magistrates and town councils for the time being; in other burghs, the commissioners may be elected by the householders. The powers proposed to be granted to the commissioners are very comprehensive, and relate to the assessment of property, the appointment and the regulation of the duties of officers and constables; the lighting of burghs; the cleansing, paving, maintaining, and naming the streets; the removal of obstructions; the laying out of new streets; the public and private drainage; the supply of water; general police regulations, extending to the most minute details; and the preservation of the public health. For the discharge of these extremely onerous duties, the commissioners are not to receive any emolument; and they are very properly prohibited from deriving any profit from work of any description performed under the Act. Nor will it, perhaps, be considered an exception to this wholesome rule, by those who know anything of Scotch towns, that by the 124th clause, "the dust, dung, ashes, rubbish, and filth within the burgh shall be, and the same are hereby, vested in the commissioners." Some of the domestic arrangements they will have to attend to are, indeed, not such as are calculated to add either pleasure or dignity to the administration of their powers. They are to prevent the deposit of horse-dung and cow-dung in the streets; to see to the construction of water-closets on the various flats, and to the clearance of soil-pipes; to provide for the cleansing of public staircases; to prevent any street-doors from opening outwards; to restrain occupiers of houses from throwing rubbish and other matters into the streets; to remove pigsties from the fronts of houses; to punish every person who hangs linen or clothes upon rails or fences; to put a stop to the barking of dogs in private houses; and to attend to innumerable other matters that seem to require regulation in Scotch burghs. The clauses of the Bill relating to public lighting are comparatively few, and some of the provisions are peculiar to towns in Scotland. By the 117th clause, the commissioners are authorized "to make provision for lighting, in a suitable manner, the whole streets, lanes, squares, public passages, thoroughfares, and places within the burgh; and to provide, erect, and maintain, such a number of lamps, lamp-posts, lamp-irons, and other appurtenances, as may be necessary for that purpose; and to light, or to enter into contracts for lighting, and cause to be lighted, such lamps, by means of oil or gas, or such other light of an improved kind as they may find expedient." The

two next clauses relate to the breaking, damaging, or extinguishing any lamp, either wilfully or accidentally. Any person seeing such an offence committed, is authorized to seize the offender, and deliver him into the custody of the police. The penalty named in the Bill for such an offence is a fine of £10, besides making good the damage done. In cases of accident, compensation for the amount of injury is to be enforced by authority of the magistrate, if not paid on demand. The supply of gas to the public lamps, by the owners of any gas-works, is rendered compulsory; and, if the gas company and the commissioners cannot agree as to the price, it is to be settled by arbitration; and, for that purpose, the clauses of the Lands Clauses Consolidation (Scotland) Act, 1845, relating to the settlement of disputes by arbitration, are to be incorporated in the Act. The owners of common stairs are, within seven days of being required by the commissioners, to light such stairs in a suitable manner, or, in default, to be liable to a penalty not exceeding 40s. for every day beyond that time. In the two succeeding clauses (122-3), gas-lighting is assumed to be established, and it is accordingly provided that, if the lamps on common stairs, or in any private street or court, "are not regularly cleaned and lighted with gas" during such hours as are fixed by the commissioners, the occupiers, in one case, and the owners, in the other, are rendered liable to a penalty of 10s. for each offence. In another part of the Bill, relating to the laying of new streets (clauses 164-5), it is further provided that, "If the commissioners deem it necessary to raise, sink, or otherwise alter the situation of any water-pipe or gas-pipe, or other water-works or gas-works laid in any of the streets," they may require the person to whom such pipes or works belong "to cause forthwith any such pipes or works to be raised, sunk, or otherwise altered in position, in such manner as the commissioners may direct," provided the alterations would not permanently injure the works, or prevent the gas or water from flowing as freely as before. The expenses of such alterations, and full compensation for every damage done thereby, are to be paid by the commissioners, who may authorize the work to be done, if their notice be not attended to. The bill does not empower the commissioners either to construct gas-works or to purchase the works of any established gas company.

A parliamentary return of the expenses incurred in carrying into effect the Sale of Gas Act, from June 30 to December 31, was issued on the 26th of last month, from which we learn that, during the half year, a further sum of £674. 13s. 4d. was expended, or rather squandered, for that object. The principal items are half a year's salary to Mr. Tomkins, who is "temporarily employed," at the rate of a guinea and a half per day; and the payment to Mr. George Glover of £250 as "remuneration for his services in superintending the construction of the gas measures to June 30, 1861." It appears, therefore, from this and the former return, that Mr. G. Glover has already received a sum total of £721 of the public money; no bad return for £40 invested in a patent for an instrument, not one of which is practically used for the purpose for which it was designed. It is lamentable to see the manner in which an Act for effecting an important public object has been twisted, perverted, and jobbed, from the commencement of the attempts to put it in operation, at a cost to the public of ten times the amount that was really required, and to the great inconvenience of all concerned in the supply of meters. To Mr. George Glover it has proved an important boon, for, independently of direct pecuniary advantage, it has been the means of bringing him into notice, and has thus served to advance his interests in his new capacity of meter-manufacturer, in which he appears in the Post-Office London Directory for 1862. The parliamentary return includes the number of copies of standard instruments, stamped and supplied by the Exchequer, from the 30th of June to the 11th of February last. During that period, ninety-six gasholders—most of them of ten feet capacity—and one cubic-foot bottle, were supplied to municipal and other authorities; the City of London, Edinburgh, and the Metropolitan Board of Works, having received a large proportion of the whole. The first gasholder delivered to the Metropolitan Board of Works was on the 17th of October; twenty-five others have since been supplied to them; ten were sent to Edinburgh; and five were supplied to the City of London, in addition to those with which the inspector's office was previously furnished.

Much interest attaches to the trial now in progress in the City of the application of the carburetting process to the street-lamps. Naphtha boxes have been fixed to about 1200 lamps, though we believe that not more than 800 of them have yet been supplied with naphtha, the old five-feet burners being retained in such cases. The public cannot, therefore, at present judge of the illuminating effect of the three-feet burners, with the carburetting process applied; but we hear several complaints of the inequality of the lighting in the City, some of the lights apparently deriving no luminosity from bringing the gas in contact with the naphtha. No correct opinion can, however, be yet formed respecting the comparative illuminating power of five feet of ordinary gas, and three feet of gas that has been naphthalized. But, admitting the two lights to be equal, the all-important question of cost will remain to be decided. It is not only the cost of a given amount of light to the City authorities that will have to be taken into account in determining the merits of the carburetting process, but it will be requisite to look also at the profit and loss account of the "Carburating Company." It will be some time, therefore, before we can arrive at a correct estimate of the advantages, if any, of this new mode of lighting.

We have inserted in another column a letter from Mr. Anderson on the Worthing award, in reply to the letters of Mr. Rutter and Mr. Wells in our last. The explanations of those gentlemen have failed to remove Mr. Anderson's objections, which he rests on more general ground than the proportionate difference between the quantity of gas consumed in a metered and an unmetered lamp. Mr. Rutter has intimated to us his intention of sending a communication for publication in our next number on "Gas to street-lamps—contracts—averages—meters;" we shall therefore, defer further remarks on the subject until we have heard both sides in this controversy.

The right of the public to the uninterrupted use of the highways, where no statutory power has been granted to obstruct them, has been again affirmed by the trial at the Surrey Assizes of the indictment laid against Mr. Train, and a number of the members of the Lambeth vestry, for laying down tramways in the roadway leading from Westminster Bridge to Kennington Park, and making it dangerous to the public. Chief Justice Erle laid it down as the law of the land that every subject had a right to "pass and repass at all times, and at their free will and pleasure, and with horses and carriages, everywhere on the highway, and on every part thereof;" and, as the jury found that the laying down of a tramway rendered the road unsafe and inconvenient in a substantial degree, a verdict of guilty was taken against Mr. Train and his foreman, subject to certain points of law reserved; but the prosecutors consented to the verdict against the other defendants being suspended till these points had been argued and decided. The principle involved in the Sheffield and Longton cases is thus again affirmed, and the obstructing of a highway by breaking it up for the purpose of laying gas-pipes by anybody or person without statutory powers remains an indictable offence, and may be punished by fine or imprisonment.

We are reluctantly compelled by the pressure upon our columns to defer the publication of the quarterly Share List till the next issue, and we shall be obliged to our readers for any further corrections they may be desirous of making before the 19th inst.

Communicated Article.

REMARKS ON THE MANAGEMENT OF CLAY RETORTS.

By Alfred Kitt.

[*Continued from Page* 145.]

The retorts are made in two pieces, and jointed together with fire-clay. The next figure shows part plan of furnace and seating for middle retorts for this setting; the tiles over the flues are supports for the ends of each piece which rests on them. There are five furnace-bars, 2 feet 6 inches in length, rounded off on the upper surface, and with square ends to keep them in position. Over the door-frames is placed a 6-inch lintle, and 4½-inch brickwork is carried up to the upper retort for support of mouthpiece and ascension-pipes. The flues run over the top of the bed from the chamber beneath, economizing the furnace heat. It will be seen by Fig. 9 that the retorts have dead ends, and are 8 feet long, and only adapted for small works; the arrangement of this setting is extremely good, and the heat is equally diffused throughout the oven.

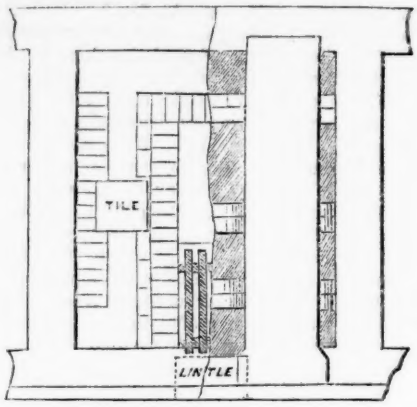

Fig. 9.
[Scale—One-quarter of an inch to one foot.]

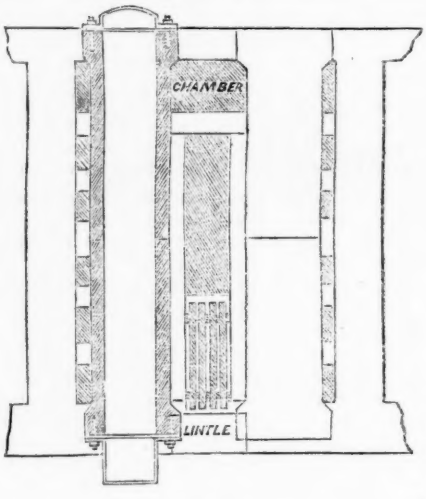

Fig. 10.
[Scale—One-quarter of an inch to one foot.]

The same plan is carried out in Fig. 10, where the retorts are 10 feet long, and fitted with back and front mouthpieces. The back end is only to be taken off for scurfing, and is to be fitted with a tile. A charge of coals can be completely carbonized in four hours in this oven, and the setting itself quite prepared for charging within twenty-four hours after first firing up.

Fig. 11 is a sectional elevation of a bed of six, with one fire at each end. The oven consists of an arch of three rings of brickwork, and is 6 feet 9 inches in width, and 8 feet in height from ground-floor, set with six oval clay retorts, 21 inches by 15 inches, and 18 feet long. The retorts are made in three pieces, and rest on piers, as shown in Fig. 12. Over the furnace, an arch of two rings of brickwork runs through the bed for the support of the middle retorts; also, resting on the retorts, another arch similarly supports the upper vessels; both these arches have suitable nostril-holes affording free passage for the furnace heat, which, after passing over the top of the oven, goes down the sides to the flues, as shown in Figs. 9 and 10.

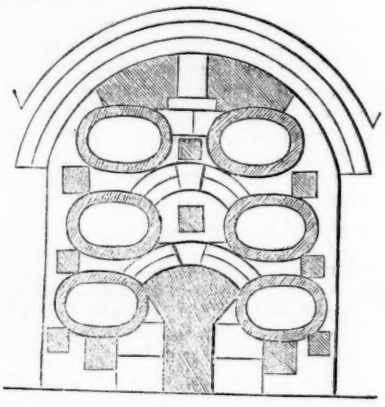

Fig. 11.
[Scale—One-quarter of an inch to one foot.]

From this arrangement, the fierce heat cannot possibly injure the retorts, and the whole of the furnace fire is employed to great advantage. The width of the furnace is 15 inches; fire-bars, 2 feet 6 inches in length; both the furnaces are kept distinct from each other by 4½-inch brickwork carried up to the main flue. The amount of coal carbonized in this bench is over the five tons in the twenty-four hours; so that, with a yield of 9000 feet to the ton, 45,000 cubic feet are made. This large make is effected by great economy of fuel, and seldom exceeds 20 per cent. of the coal carbonized.

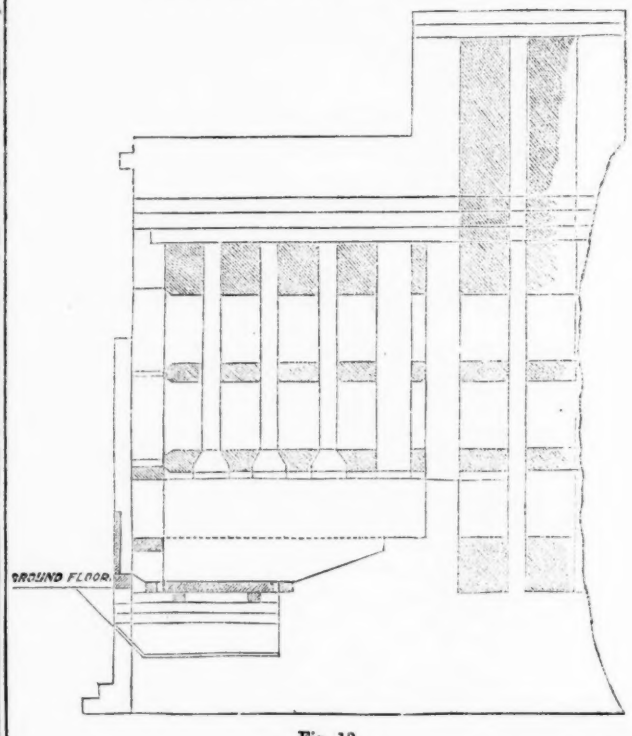

Fig. 12.
[Scale—One-quarter of an inch to one foot.]

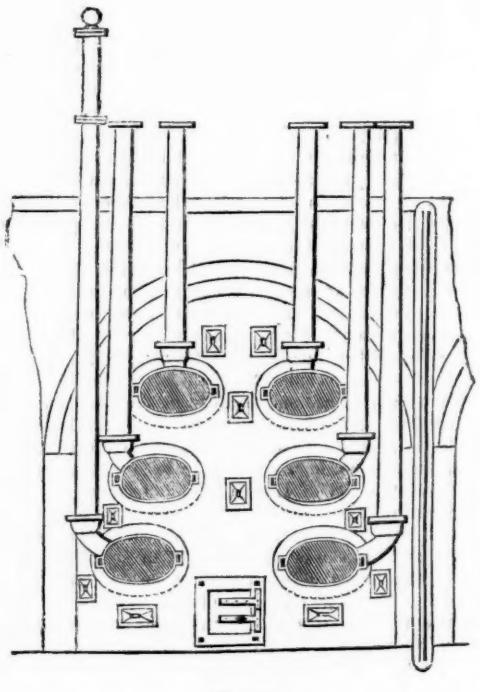

Fig. 15.

The duration averages from four to five years before requiring resetting; and, during that period, the furnaces will require repair but once during the whole time they are in action.

A capital setting of seven clay retorts, of all one size, is represented by the next figure, showing a sectional elevation.

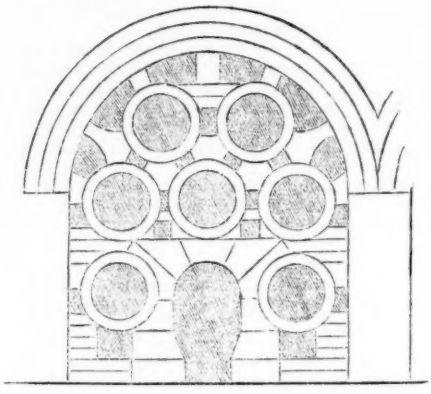

Fig. 13.

[Scale—One-quarter of an inch to one foot.]

The retorts are 15 inches in diameter and 20 feet long, made in pieces of 5 feet each; the ends of each of these pieces are supported on 9-inch work, and firmly put together and cemented by fine fire-clay mortar. The ovens are 8 feet 3 inches in height from ground-floor, and 6 feet 6 inches wide; the arches are formed of three rings of brickwork, all made of fire-brick, and set on edge. The foundation and backing-up of these may be of old red brick and good lime mortar.

The furnace is 14 inches wide, and 3 feet in height from ground-floor, and consists of an arch running throughout, having nostril-holes at the sides, as seen in Fig. 14. The front of the furnace, and that part of it immediately over the fire, is built up with solid lumps to within 3 feet of the face of the work. The furnaces are parted from each other, and the flues run into separate chambers, divided by a 9-inch wall, and over the top of the bed to the main flue, which is 16 inches square.

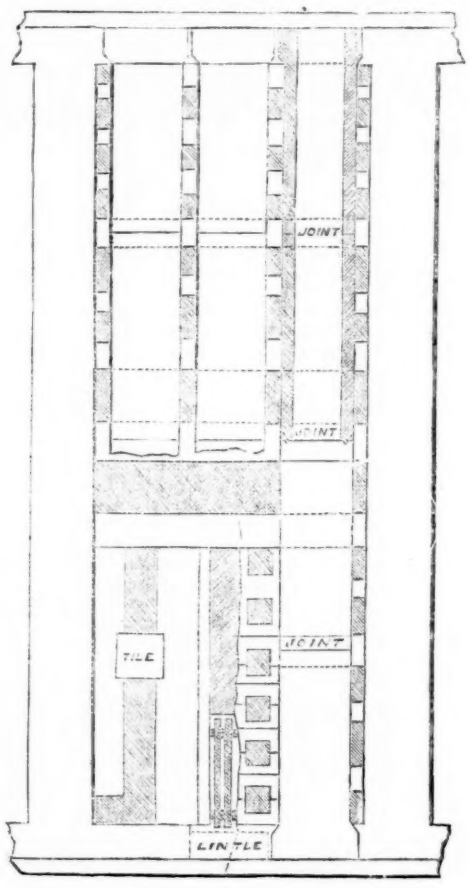

Fig. 14.

Fig. 14, is a part plan of furnace, and shows seating for bottom and middle retorts sufficiently correct to exhibit the general arrangement. The back of the furnace, from the fire-bars, slopes gradually back, and upwards to the wall of the back chamber.

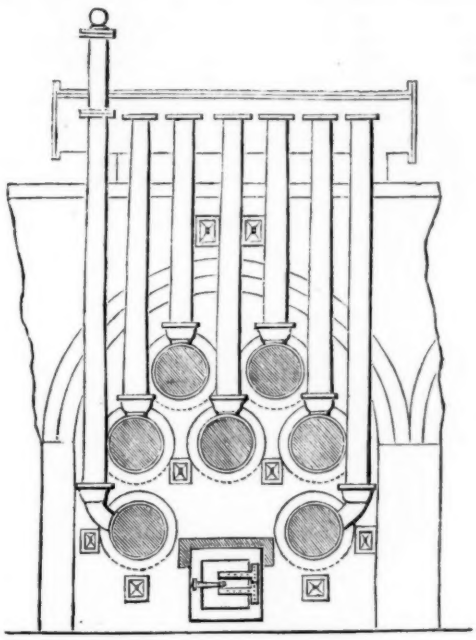

Fig. 16.

Fig. 16, is an elevation of this setting, and shows lintle over door-frame, mouthpieces, and ascension-pipes. The charge of coal per retort is 3½ to 4 cwt. The fuel necessary for heating averages 25 per cent. of the coal carbonized. A bed of retorts set in this manner will last from three to four years, and, during that period, the furnace, if constructed of the best fire-clay goods, will continue to work, almost uninterruptedly, without repair.

The following is a rough estimate of fitting up a stack of twelve ovens of six 18-feet clay retorts, set as Figs. 11, 12, and 15. The ascension, dip, and H-pipes are all flanged; the hydraulic is made of cast iron, D-shaped, 18 inches by 14 inches wide, also flanged:—

Quantities, and First Cost of Setting.

96,000 common stocks 110,000 best feather-edge arch and crown bricks, &c., &c. 108 3-inch tiles 24 2-inch damper-tiles 1132 assorted lumps	£600	17	0
	57	3	0
30 tons of clay	45	0	0
40 ditto of sand	8	0	0
10 loads of lime	6	0	0
24 door-blocks	0	16	0
1296 feet of retorts, at 7s.	453	12	0
48 14-inch tiles	0	18	0
12 lbs. of sal ammoniac	0	6	0
Centres for arches, furnaces, &c.	100	0	0

Ironwork.

200 feet of 1½-inch round iron	4	19	9
120 feet of furnace-bars	6	8	0
240 cast-iron sights	25	16	0
30 wrought-iron butt-staves	29	4	9
13 tie-bars	6	3	6
24 cast-iron ash-pans	16	13	0
24 door-frames	12	0	0
96 cramps	4	16	0
180 feet, 2-inch square bearing bars	10	17	6
96 ½-inch plates, holding-bolts, &c., to door-frame	3	18	6
144 cast-iron mouthpieces, each 2¼ cwt.	144	0	3
144 lids 864 ⅞-bolts and nuts 864 washers	22	4	0
144 sets, ears, cotters, screws, &c.	52	4	0
144 ascension-pipes 144 N-pipes 144 dip-pipes	205	8	0
Carried forward	£1817	5	3

Brought forward . . .	£1817	5	3
1166 ¾-inch bolts and nuts . . .	2	15	0
1166 washers			
203 feet flanged D-hydraulic	240	0	0
576 caps for H-pipes	30	0	0
1152 bolts, nuts, and washers . .			
6 cast-iron legs for hydraulic	13	0	0
Estimated labour, at £22. 10s. per bed .	270	0	0
15 per cent. contractor's profit for arches and ironwork	315	9	0
Allowances, contingencies, at 5 per cent.	105	3	0
	£2793	12	3

Or, £232 16s. per complete setting, and £19s. 8s. per mouthpiece.

The following is an estimate of materials and labour for one bed of seven retorts each 20 feet long, and 15 inches in diameter, as represented set as figs. 11, 12, and 14, including hydraulic main and all necessary fittings, &c.

Clay Goods.

140 feet retorts, at 6s.	£42	0	0
4 tons fire-clay, at 20s.	4	0	0
5 tons of sand, at 4s.	1	0	0
2 loads of lime	1	5	0
2 cwt. of borings, at 5s.		10	0
16 main-flue tiles, 24 in. by 12 in. by 3 in., at 1s. 6d.	1	4	0
2 damper tiles, at 1s. 3d.		2	6
32 cross-flue tiles, at 5d.		13	4
8 large saddles	3	16	0
12 small do.			
32 jamb bricks			
3000 red bricks, at 25s.	3	15	0
1600 arch / 10,000 fire at 84s.	46	6	10
Door, blocks, furnace-lumps, & lintles, &c.	45	8	0

Ironwork.

14 sight boxes	1	10	0
14 mouthpieces	11	4	0
36 bolts and nuts for ditto, 8 in. . . .		18	0
14 screws and cross-bars, cotters, ears, &c.	5	12	0
2 door-frames and doors	1	3	1
Bed plates, bearing, and furnace bars. .	1	15	8
14 wrought-iron retort-lids	2	2	7
250 washers, bolts, and nuts, cramps, &c.		10	0
Butt-staves, bolts, bars, &c.	3	10	0
2 lengths hydraulic main	20	0	0
14 ascension-pipes . / 14 N-pipes . . . / 28 caps for N-pipes / 14 dip-flanged pipes / 2½ tons, at £7. 15s.	19	9	6
Labour in setting	25	0	0
Contractor's profit, 15 per cent. . . .	32	13	3
Allow contingencies, 5 per cent. . . .	10	17	9
	£286	6	6

Costs of retorts per mouthpiece in this setting £20. 9s.

(*To be continued.*)

Correspondence.

STREET-LIGHTS SUPPLY.

Sir,—Mr. Rutter has now explained more fully the terms to which the Worthing Gas Company is bound by the recent arbitration. This explanation contains only one redeeming quality, which was not mentioned in the abstract of award given in the Journal of 28th January. With this exception—the double tap, whereby the size of the light *may* be regulated—the injustice which it inflicts on the gas consumers and the gas company stands unmitigated, unexplained. Under these circumstances, it is much to be regretted that Mr. Rutter did not *disagree* with the arbitrator for the local board, and leave the decision of the question to an umpire, which, doubtless, he had the power to do.

So far as the contract, settled by the arbitration, differs from the one about to expire, it seems to be in the addition of stringent measures inflicted on the gas company. In the first place, it begins with a reduction in the price of gas to the street-lamps, of 4d. per 1000 feet, whilst the existing price is already 25 per cent. below that paid by the private consumer. Surely, the decision of an umpire would have improved this state of things for the gas company.

Second, the company is now bound to give a *minimum* pressure of 7/10ths throughout the entire system of their mains (wherever there is a street-lamp) from sunset to sunrise, whether the street-lamps be lighted or no. I quote from the abstract of award. "The company is to furnish a sufficient supply of gas, having the illuminating power and purity hereinafter described, for lighting at all such periods of the year, during the said term, *upon such days and nights, and during such hours* as the local board shall direct, the lamps now set up within the town, or hereafter to be set up, which gas shall have a pressure, at every lamp-post, between the hours of sunset and sunrise throughout the year, of not less than 7/10ths of an inch head of water."

Mr. Wells, the manager of the works at Worthing, who has come to Mr. Rutter's rescue, states that the local board light and extinguish the lamps when they choose. They extinguish, he says, at one, two, or three o'clock, according to their own views. You will now see the force of the portion of the quotation from the award which I have put in Italics.

The pressure is absolutely to be maintained in the main, although the street-lights may be shut off at one, two, or three o'clock in the morning, for the award distinctly permits that the local board may omit to burn gas any evening they think proper, whilst it distinctly states that, between the hours of sunset and sunrise, the (minimum) pressure must be kept at 7/10ths throughout the whole year.

Will Mr. Rutter inform us why he so tamely submitted to such an absurd clause as this being inserted in a public lighting contract, and who it was that drew it?

Now, as to the pressure. I submit that it is unnecessarily large, to give 7/10ths as a minimum; more must be given at many places; and to give this all night must lead to a waste of gas by leakage, injurious to the gas company: 5/10ths would have been quite enough, and, if the opinion of any competent gas engineer had been taken, I have no doubt a pressure of 5/10ths would have been carried. Mr. Rutter objects to my experiments, which showed that the local board would get more gas than they paid for; but, as he does so only by hypothesis, and not from experiments of his own, I think it unnecessary to vindicate what I have previously stated.

I admit that the double cock will, if attended to, assist in mitigating the evils of which I complained; but it only mitigates, and does not remove, my objection, that the unmetered light will burn more gas than the metered one, owing to the pressure lost in the meter; and, to paraphrase one of Mr. Rutter's sentences, "It is no new discovery on the part of Mr. J. O. N. Rutter," to put a double tap to a street-lamp. I have seen this done, thirteen years ago, in Holland, not by the clumsy mode adopted at Worthing, of putting a half-inch main-cock in addition to the ordinary lamp-cock, but with both cocks formed in the same brass casting.

In the fourth paragraph, Mr. Rutter seems to imagine that the reason why I object to the terms of the Worthing award is, because in it he has endeavoured to arrive at a real, instead of continuing a fictitious, price for gas. Why, my objection is directly the contrary; for I contend that there is no reality, as the metered lamp and the unmetered one will not burn alike; and, to make the one a test for the other, is to perpetrate a fallacy, and Mr. Wells has proved it, for by his experiment a metered light burned 5·7, while an unmetered one burned 6 feet.

In the fifth paragraph, Mr. Rutter objects to my drawing a parallel between a public light and a private consumer, and asks the question, "who would ever think of it"—the public lamps—"being one hundred and fifty separate transactions?" The local board, he says, is the largest consumer, and is entitled to have the gas at a lower price.

Now, I have heard this language held before, and am not surprised to hear it repeated by Mr. Rutter; but it is wrong, and can only be held by persons who have not thoroughly studied the subject. Let us consider the matter. To the local board at Worthing there are 150 services to their 150 lamps; and, doubtless, many of those services are long ones. They require the pressure kept up in the mains during the entire night. Now, the ordinary class of small private consumers will burn several lights on the one service, and they do not require the pressure maintained at more than 3/10ths or 4/10ths, if at all, after bed-time. Does Mr. Rutter now see that the local board is not only, in effect, 150 small consumers, but 150 consumers with very disagreeable requirements?

Speaking as a secretary, sitting in his office, Mr. Rutter is right: in the matter of account, there is one large sum, as if for a large consumer, and there is very little risk or loss from bad debts; but what does this risk amount to? why, about 2 per cent. on the average of cases. Local boards are, therefore, on the whole, not entitled to receive gas below the price paid by small consumers.

I trust these observations will alter Mr. Rutter's views, and that the next time he is engaged on similar business he will resolutely stand for a price per 1000 for street-lights similar to that paid by private consumers. Mr. Richards, the umpire in the Waterford arbitration, took this view; and, after four days evidence, he came to the conclusion which Mr. Rutter says is so refreshing*—"he could not see how the practice he referred to could be supported by any intelligent person"—that practice was, charging one price to private and another to public consumers.

Since the remarks on the Worthing case have appeared, I have received several letters from gas managers, thanking me for having drawn attention to the matter. I am also informed by a gentleman who is engaged in the profession, and who knows the previous circumstances of Worthing well, that not only was the gas company dissatisfied, but so also was the local board—that it was a continual war—that the squabbling, as reported in the local papers,

* See the number of this Journal for Jan. 28, 1862, page 60, for a *verbatim* report of Mr. Richards's award in the Waterford case.

was almost constant—and this alleged state of things is somewhat corroborated by the letter of Mr. Wells, the manager, who, writing of the old contract, says, "We were, by the terms of the contract, entirely at the caprice of the servants of the local board. I am alive to some of the difficulties which result from the board having such control of the lamps." I take notice of this, as Mr. Rutter states that the contract "now existing having given great satisfaction to the respective contracting parties, it was considered that it contained the principal conditions for another. There had been no complaints or disputes on either side." I leave Messrs. Rutter and Wells to settle those discrepancies between them, as they cannot both be right.

With the concluding paragraph of Mr. Rutter's remarks, I entirely concur, that "the award at Worthing is not likely to affect awards in other places." I sincerely hope not; and, after the ventilation it has received, I do not think it will. I am happy, therefore, to take leave of this subject in accord with Mr. Rutter.

16, *Adam Street, Adelphi.* GEORGE ANDERSON.

Register of New Patents.

2102.—WILLIAM BAINES, of the London Works, Smethwick, Stafford, engineer, for "*Improvements in the construction of girders, frames, or other apparatus, fixed or moveable; and for certain peculiar forms or sections of iron used therein.*" Patent dated August 22, 1861.

In the forms or sections of plates used in the construction of these frames, or compound girders, one part is male and the other female. By bringing these parts together they become inserted, and being secured by bolts or rivets, effect a vertical union and continuous bearing, branching or extending where required; and, in constructing the moveable parts of railway turn-tables, the plates are bent, and formed into suitable parts or segments, and secured in their respective places by bolts or rings, thus constituting one entire frame, forming its necessary cross-girders, which can be produced to suit any angle for any number of roads upon the table.

The claim is for the form or section for plates, and the method of securing them, so that they mutually support and strengthen each other; also, the method of bending and forming the segments or turn-tables as described.

2176.—EDWARD JOSEPH HUGHES, of the firm of Hughes and Son, patent agents, 123, Chancery Lane, London, for "*An improved apparatus for collecting the gases which escape from furnaces.*" A communication. Provisional protection only obtained. Dated Aug. 31, 1861.

Upon the plate of the furnace, and surrounding its opening, is a conical cast-iron ring, fitted round the chimney, and provided with a suitable number of openings to feed the furnace. At the upper part of the furnace is placed a helmet-shaped pipe for receiving and delivering the gas as collected. Around the bottom end of the said receiving-pipe, is riveted an angular iron-hoop, which serves as a base for another conical ring, which surrounds the gas-pipe; which ring, by means of vertical bars and screws, can be brought into a horizontal position. The apparatus is provided with a cover, which can be raised by balance-levers to admit of the materials to be melted. A hemispherical valve is provided which closes by its own weight, and opens if the gases, freely flow thus serving as a safety-valve. To prevent the bursting of the cover and the conical rings, a narrow piece of sheet metal is riveted on them.

APPLICATIONS FOR LETTERS PATENT.

785.—JAMES NEWALL, of Bury, Lancashire, railway-carriage builder, for "*Improvements in supplying gas to railway-carriages, stations, steam-boats, and other vessels, omnibuses, or other carriages, at any required pressure.*" March 21, 1862.

804.—THOMAS FREDERICK HALE, of Bristol, brass-founder, for "*Improvements in valves.*" March 22, 1862.

811.—SAMUEL ELLISON TURNER, of Birkenhead, Cheshire, for "*An improved apparatus for burning a mixture of inflammable gas and air.*" March 24, 1862.

819.—ECHLIN MOLYNEUX, junior, of Seaview, Enniskerry, Wicklow, for "*Improvements in air, gas, and vapour-engines.*" March 25, 1862.

824.—THEOPHILE GUIBAL, of No. 43, Rue des Groseillers, Mons, Belgium, civil engineer, for "*Improvements in the construction of ventilators for the ventilation of mines and furnaces.*" March 25, 1862.

826.—WILLIAM PALMER, of Sutton Street, Clerkenwell, London, E.C., for "*Improvements in lamps.*" March 25, 1862.

838.—JOHN TAYLOR, civil engineer, and CHARLES HENRY MINCHIN, accountant, both of Manchester, Lancashire, for "*A suspender or improved gallery for supporting the shades of gas, or other lights.*" March 26, 1862.

862.—JAMES JONES, of Mersey Bank, Warrington, Lancashire, engineer, for "*Improvements in apparatus for raising and forcing liquids.*" March 28, 1862.

866.—EUGÈNE THEODORE NOUALHIER, of Paris, manufacturer, for "*An improved ventilator.*" March 28, 1862.

869.—EDMUND SMITH, of Hamburgh, gas-meter manufacturer, for "*Improvements in wet gas-meters.*" March 28, 1862.

921.—HERMAN LORENZ, and THEODORE VETTE, of Berlin, Prussia, for "*Improvements in filters.*" April 1, 1862.

927.—WILLIAM MALAM, of Skinner Street, London, E.C., gas engineer, for "*An improvement in the manufacture of gas, and improved apparatus to be employed in such manufacture.*" April 2, 1862.

GRANTS OF PROVISIONAL PROTECTION.

257.—HERMAN SCHATTEN, of Hesse Cassel, civil engineer, for "*Improvements in the manufacture or construction of gas-meters.*" Jan. 31, 1862.

289.—THOMAS MOSSOM MEEKINS, LL.D., of the Inner Temple, Esq., Barrister-at-law, and of 44, Chancery Lane, London, W.C., for "*The production of a projectile and explosive force to be used in instruments of war, for an electric gas-gun and electric gas-shell, for a method of using the recoil of weapons, for the purpose of increasing the pressure of elastic fluids, for the production of a projectile force, for a method of rapidly loading weapons at the breach, and of a motive force to be used in an electric gas-engine, or other engines.*" Feb. 4, 1862.

439.—FREDERICK BARNETT, of 230, Oxford Street, London, W., for "*An improved lamp or lantern for street-lighting, and other purposes.*" Feb. 19, 1862.

499.—JOHN CARNABY, of 7A, Skinner Street, London, E.C., patentee and manufacturer of apparatus for the safe and economical use of gas, for "*Improvements in turning, managing, and regulating the taps and valves of gas-pipes.*" Feb. 25, 1862.

555.—JAMES SIM, of Aberdeen, N.B., manufacturing chemist, for "*Improvements in the construction of gas-meters.*" March 1, 1862.

559.—PIERRE JOSEPH GUYET, of Paris, civil engineer, for "*Improvements in taps or valves.*" March 1, 1862.

578.—THOMAS TILLAM, of Church Street, Deptford, Kent, cremating manufacturer, for "*An improved method of purifying gas.*" March 3, 1862.

635.—FRANCIS ROBERT NEWTON and HIRAM CODD, both of Esher Street, London, S.W., for "*An apparatus for indicating and measuring the flow of liquids.*" March 8, 1862.

664.—ALPHONSE RENE LE MIRE DE NORMANDY, of Odin Lodge, King's Road, Clapham Park, London, S., for "*An improved method of connecting gas, and other pipes.*" March 12, 1862.

692.—RICHARD ARCHIBALD BROOMAN, of 166, Fleet Street, London, E.C., patent agent, for "*Improvements in apparatuses for measuring and regulating the flow and pressure of gas, parts of which are applicable to hydraulic receivers, and to steam-generators.*" A communication. March 13, 1862.

699.—RUDOLPH SCHOMBURG, of 90, Cannon Street, London, E.C., and ADOLPH BALDAMUS, of Charlottenburg, in the city of Berlin, Prussia, for "*Improvements in purifying illuminating-gas.*" March 13, 1862.

705.—GEORGE HENRY SANBOIN, of Boston, State of Massachusetts, U. S. A., for "*Improvements in gas-regulators.*" A communication. March 14, 1862.

722.—JOHN AVERY, of 26, Mark Lane, London, E.C., for "*Improvements in purifying coal.*" A communication. March 15, 1862.

727.—WILLIAM CLARK, of 53, Chancery Lane, London, W.C., engineer and patent agent, for "*Improvements in water-meters.*" A communication. March 17, 1862.

731.—LOUIS PIERRE MONGRUEL, of 7, Rue Vivienne, Paris, for "*An improved cold vapour generator, which may also be used in the carburation of illuminating gas.*" March 17, 1862.

734.—JOHN WEEMS and WILLIAM WEEMS, both of Johnstone, in the county of Renfrew, N.B., engineers, for "*Improvements in apparatus for indicating the pressure or quantity, and in regulating the discharge of fluids.*" March 17, 1862.

744.—THOMAS MYERS, of Brighton, Sussex, gentleman, for "*Improvements in meters for measuring water, gas, or other fluids.* March 17, 1862.

759.—FREDERICK WARNER, of 8, Crescent, Cripplegate, London, E.C., for "*Improvements in cocks or taps.*" March 18, 1862.

765.—ROBERT WILSON, of Patricroft, near Manchester, Lancashire, engineer, for "*Improvements in hydraulic presses, and in machinery or apparatus for raising or forcing liquids.*" March 19, 1862.

778.—EDWARD FIELD, of Buckingham Street, Adelphi, London, W.C., consulting engineer, for "*Improvements in apparatus for regulating the flow of gaseous, and other fluids.*" March 20, 1862.

804.—THOMAS FREDERICK HALE, of Bristol, brass-founder, for "*Improvements in valves.*" March 22, 1862.

824.—THEOPHILE GUIBAL, of 43, Rue des Groseillers, Mons, Belgium, civil engineer, for "*Improvements in the construction of ventilators for the ventilation of mines and furnaces.*" March 25, 1862.

838.—JOHN TAYLOR, civil engineer, and CHARLES HENRY MINCHIN, accountant, both of Manchester, Lancashire, for "*A suspender or improved gallery for supporting the shades of gas, or other lights.*" March 26, 1862.

NOTICES TO PROCEED.

2901.—LUKE SMITH and MATTHEW SMITH, both of Heywood, near Manchester, Lancashire, mechanics, for "*Improvements in raising liquids, and in apparatus connected therewith, parts of which are applicable to improving the quality of fermented liquids.*" Nov. 19, 1862.

2933.—RENIL DE CLERCQ and EMILE CHAZELLES, of Brussels, Belgium, mechanical engineers, for "*Improvements in apparatus for raising and supplying water to boilers, and for other purposes.*" Nov. 22, 1861.

2944.—JOHN WEEMS, of Johnstone, Renfrew, N.B., tinsmith, for "*Improvements in the manufacture of metallic tubes, and in coating or plating metals.*" Nov. 23, 1861.

3006.—BENJAMIN PITT, of 3A, Great Carter Lane, London, E.C., engineer, and JAMES JOHN SHEDLOCK, of 1, Weardale Villas, Earl's Court, Kensington, W., for "*Improvements in cocks or valves for the passage of fluids.*" Nov. 28, 1861.

264.—Edward Henry Cradock Monckton, of Fineshade, in the county of Northampton, Esq., for "*Improvements in the application of electricity for obtaining ammonia, and other useful products, during the combustion of coal and fuel, and in the apparatus employed therein.*" Jan. 31, 1862.

555.—James Sim, of Aberdeen, N.B., manufacturing chemist, for "*Improvements in the construction of gas-meters.*" March 1, 1862.

571.—Henry Bowen, of Cardiff, Glamorgan, gas engineer, for "*Improvements in gas-meters.*" March 1, 1862.

650.—Henry Herman Kromschroeder, of 32, Princess Terrace, Regent's Park, London, N.W., for "*Improvements in gas-meters.*" March 10, 1862.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, March 24, 1862.

The Caterham Water-Works Bill was read a third time, passed, and sent to the Commons.

The Bradford Corporation Water Bill was brought from the Commons, read a first time, and referred to the Examiners.

Tuesday, March 25.

The Bollington (Prestbury) Improvement and Lighting Bill was brought from the Commons, read a first time, and referred to the Examiners.

Thursday, March 27.

The Leeds New Gas, the Falmouth Water, and the Dundee Water Bills, were read a third time, passed, and sent to the Commons.

Friday, March 28.

The Stretford Gas Bill was committed.

The Barnsley Local Board of Health and the Heckmondwike Gas Bills were brought from the Commons, read a first time, and referred to the Examiners.

Monday, March 31.

The Wakefield Water Bill was committed.

Tuesday, April 1.

The Bradford Corporation Water Bill was read a second time and committed.

The Kent Water Bill was reported, with amendments.

Thursday, April 3.

Petitions were presented against the Bollington (Prestbury) Improvement and Lighting Bill, from the ratepayers of Bollington, and James Lee Harwar and persons signing.

Friday, April 4.

The Kent Water Bill was read a third time, passed, and sent to the Commons.

HOUSE OF COMMONS.

Monday, March 24, 1862.

The Bollington (Prestbury) Improvement and Lighting Bill was read a third time and passed.

The Barnsley Local Board of Health and the Heckmondwike Gas Bills, as amended, were considered, and ordered to be read a third time.

The Woolwich, Plumstead, and Charlton, &c., Gas, and the Kent County Gaol and Lunatic Asylum (Water Supply) Bills, were read a second time and committed.

The Leeds Water Bill was read a first time, and referred to the Examiners.

A petition was presented against the Highways Bill, and two against the Parochial Assessments Bill.

Tuesday, March 25.

The East London Water Bill was read a first time, and referred to the Examiners.

Two petitions were presented against the Highways Bill.

Parochial Assessments Bill.—Petitions against the Bill were presented from the London Gaslight Company; and eleven others.

Thursday, March 27.

The Heckmondwike Gas Bill was read a third time and passed.

Three petitions were presented against the Highways Bill.

Parochial Assessments Bill.—Petitions against the Bill were presented from the Liverpool United Gas Company, the Birmingham Gaslight Company, the Dover Gaslight Company; and six others.

Friday, March 28.

The Caterham Water-Works Bill was read a first time, and referred to the Examiners.

Five petitions were presented against the Highways Bill.

Parochial Assessments Bill.—Petitions against the Bill were presented from the Bolton Gas Company, the South Metropolitan Gaslight Company, the Preston Gas Company, the Bristol Water-Works Company, the Sunderland and South Shields Water Company, the Sunderland Gas Company, the Bath Gas Company; and five others.

Monday, March 31.

Parochial Assessments Bill.—Petitions against the Bill were presented from the Burslem and Tunstall Gas Company; and eight others.

A petition was deposited against the Kent County Gaol and Lunatic Asylum (Water Supply) Bill.

Tuesday, April 1.

The Leeds New Gas, the Falmouth Water, and the Dundee Water Bills, were read a first time, and referred to the Examiners.

Five petitions were presented against the Highways Bill.

Parochial Assessments Bill.—Petitions against the Bill were presented fram the Newcastle-unde-Lyme Gaslight Company, the Portsea Island Gaslight Company, the Leicester Water-Works Company, the Nottingham Gaslight and Coke Company, the Leicester Gas Company, the Sheffield Water-Works Company, the Derby Water-Works Company, the Ashton Gas Company; and seven others.

Wednesday, April 2.

The Leeds Water Bill was read a second time, and committed.

Parochial Assessments Bill.—A petition against the Bill was presented from the Bristol United Gaslight Company; and one other.

Thursday, April 3.

A petition was presented against the Highways Bill.

Parochial Assessments Bill.—Petitions against the Bill were presented from the Staffordshire Potteries Water-Works Company, the Lancaster Gas Company, the Bangor Water and Gas Company, the Derby Gaslight and Coke Company; and five others.

Friday, April 4.

A petition was presented against the Highways Bill.

Parochial Assessments Bill.—Petitions against the Bill were presented from the Imperial Gaslight and Coke Company, the Cambridge Gaslight Company, the Boston Water-Works Company, the Leeds Gaslight Company; and one other.

HOUSE OF COMMONS.

(*Before Mr.* W. O. Stanley, *Chairman*; *Mr.* Hanbury, *Mr.* St. Aubyn, *Mr.* Rogers, *and the Hon. Captain* Clive.)

BRADFORD CORPORATION WATER-WORKS BILL.

[*Continued from Page* 185.]

Tuesday, March 11.

J. W. Leather, Esq., examined by Mr. Cladon.

I am the engineer of the Bradford corporation, and was engineer of the water company before the works were purchased by them. I was concerned with the original construction of the works in 1842. According to the works as purchased by the corporation, we were authorized to carry on our water by a conduit to Bradford. We had two reservoirs on the way to Bradford. Then, a reservoir was constructed for the compensation of mill-owners, if they thought fit. About half a million gallons per day were given by that scheme. In 1854, the company obtained power to go into the valley of the Wharfe, and appropriate in that valley the following waters:—We appropriated areas of 5690 acres and of 2000 acres; and, passing under several tunnels, and across numerous bridges, we passed from the valley of the Wharfe into the valley of the Aire, where we have another area of 3180 acres, less for canal 290 acres. Then we cease our gathering, until we come to a point leading on to Bradford, where we have a level. We have a reservoir at both the compensation-areas, for storing the water. Those two areas might give 14 million gallons per day, giving to the millowners one-third. We cannot get reservoirs to store the whole of that, and we, therefore, do not expect more than from 7 or 8 million gallons a day from those two areas. On the banks of the Wharfe, we have a gathering-ground of 7390 acres. In the valley of the Aire, the ground is so extremely steep that there was no possibility of getting any reservoir into the gathering-ground. Still, we have continued to have a reservoir as marked upon the map to compensate the millowners on the river Aire. The minimum flow from these two gathering-grounds has been 1 million gallons per day. We can get 8½ million gallons into the reservoir near Bradford. In 1854, we proposed another compensation-reservoir; and, between 1854 and 1858, it was deemed necessary to make a service-reservoir. From that we gave from 900,000 to a million gallons, and that, added to our other sources of supply, gave us a total of about 10 million gallons. There was half a million the canal company; 8½ millions by the works of 1854; and an additional million by the works of 1858. Under the Act of 1854, the corporation obtained powers enabling them to purchase the old works of the company and the new. They made that purchase. The sum they gave was about £230,000, including the works and the liabilities. The Act of 1858 was obtained by the corporation. The total borrowing power of the corporation under their existing Acts is £650,000. £610,000 of that have been actually expended. The sums I have certified as still due, amount to about £21,000. I expect to have to certify for further works, which will involve a further outlay of £37,300. For reservoirs, cottages, and other matters, I put down £10,000; and perhaps £10,000 more will be required. I put down £5000 for compensation. Accommodation and other extras will bring up the sum to about £38,000. Adding that to what has been already expended, we have a total of £699,882—in round numbers, £700,000. The corporation now have only a power to borrow a lesser sum, and we want a larger margin. There have been town meetings held, authorizing the corporation to ask for a further sum of £100,000. We took a period of five years to complete the works. The high-level works were to be completed in two and a half years, but we think five years is a reasonable time within which to prescribe the limit. There is an abandonment of the conduit mentioned in the bill. It is not proposed to construct that conduit now, and I think the corporation should have power to abandon it. By the 20th section, arrangements are made to dispense with certain clauses in order to protect the interests of Mr. William Farrand. We authorize him and his heirs to deal with the corporation as they may think proper. With respect to the clause which proposes to repeal the 52nd section of the former Act, the object of the corporation in desiring the repeal of that clause is, to enable the corporation to supply water to the out-districts on the usual fair and equitable terms. There are parties in those districts desirous of having our water, and the general course of our works goes near those districts. The corporation could supply them with water, if they had this clause repealed. I know of no reason why these restrictive amounts should be retained, as they are in the former

bill. The clause which we now require to repeal has a most prohibitory effect. There is a limit as to quantity, and no one is benefited by that limit. No more water would be abstracted than would be taken, if those places were included. There is a sanitary object which would be effected by giving water to those places, and that would be effected by the repeal of the 52nd section. I am now stating that, even if we had not powers to sell to those townships, we should require for Bradford all the water we abstract—namely 10 million gallons per day. In point of fact, we should use our 10 million gallons per day, whether we supplied those out-townships or not. The population of Bradford had been increasing at a very rapid rate, and had nearly quadrupled in the course of thirty years. In the decennial period from 1841 to 1851, the increase was 50 per cent., and, had it gone on in the same ratio for the next decennial period, from 1851 to 1861, it would have amounted to 162,000; but it only reached 106,000. There was, therefore, a falling-off of 56,000 people; and that 56,000 would be larger than the whole of those out-districts contained. There is another reason for requiring the repeal of the clause, and that is, that several of those places are inadequately supplied at present. Bingley is now partially supplied by Mr. Farrand. There is a water-work company at Keighley, which could give them a quantity of water at a cheap rate—cheaper than we could supply them at. Our bill is not compulsory. It simply enables us to sell. Shipley has also a supply, and Shipley supplies Windhill. We pass through Shipley and Bingley with our conduit. We cannot get to other villages without passing through both Shipley and Bingley. The corporation of Bradford have distinctly informed the local board of Shipley that they will not give any supply to that place without the consent of that local board. Some of those places are very badly off for water indeed. The population of all those places is mentioned on the map. The Halifax corporation have an extensive power to supply water by agreement to places not only within but without their district, beyond their limits. The first suggestion of such a limitation, with regard to us, emanated from the corporation of Leeds, who proposed to take water from the Wharfe. In 1853, the corporation of Leeds gave notice of their intention to apply to Parliament, and they then applied for powers, similar to those possessed by Halifax, to supply water within and without their limits. Keighley has 18,815 inhabitants, and Shipley 7098. In point of fact, we are seeking for powers to give water to 30,000 people who have no water; and, also, to give water to others, amounting to 39,000 people, who have already a short supply.

Cross-examined by Mr. CALVERT: We have weirs as well as a compensation-reservoir. The water flows over the weirs. We do not supply Thornton at present; and the same answer applies to Clayton. I repeat that the restrictions in the clause are practically prohibitory. Some of the out-townships have wells at present, and many of them take water from springs. Water is very scarce in most of them. We may take as much water from the reservoir as we please, and waste it if we like. We shall not, under this bill, take any more water if the Act is passed than if it be not passed. Supposing our object is gained, and that these restrictions are removed, we shall not take any more water than our conduit will carry. The conduit does not enable us to appropriate the whole water of the district. We shall bring down as much water as the conduit will carry. We shall apply the whole of it to the inhabitants. If not, the remainder of it will be turned by the corporation of Bradford into the Bradford Beck, for sanitary purposes. Of course, if this bill were carried, there would be so much taken away from the sanitary purposes of Bradford, because the supply of water to that borough would be diminished. Bingley is now supplied by means of springs on the estate of Mr. Farrand. In 1858, we did not offer to include anything in the bill but what it at present contains. Mr. Farrand objected strongly at that time to Bingley being left in, and it was struck out before we took any action. I do not remember about Shipley, but, I believe, it was not in the bill.

Cross-examined by Mr. RICHARDS: In the bill of 1854, Shipley was included when the bill was deposited; but Shipley was struck out by consent on our part; and Shipley obtained their Act for having a local board. There is no doubt that Shipley has the power to supply Windhill. The powers we are now seeking are not compulsory. They are only permissive. We propose to introduce Shipley and Windhill into this bill, with this proviso, that we will not supply either unless with the consent of their respective boards. We ask now to introduce into this bill that which was struck out of our bill in 1854. We incorporate the Water-Works Clauses Act in our present bill. If Shipley and Windhill are put into our bill, the powers to supply those places would be compulsory; but then a qualification has been offered to those two districts that no water shall be supplied except with the consent of their respective boards, and that makes the bill permissive. If we entered Windhill, we should not have compulsory power to supply it, because of the qualification I speak of. We pass through Windhill in getting at Apperley, and we believe that the more places we supply the more remunerative will our project become. It is my impression that Shipley will be obliged to cast off Windhill, because of the very limited supply of water which it has for itself. The distance from our present high-water service to the centre of Idle, is about two miles. I believe Idle could be supplied by our low-level service. We propose to go to Eccleshill. There might be a few houses at the extreme summit of Idle which, perhaps, could not be reached by our low-level service, but, I believe, they could all be reached by it. They would be supplied by an off-shoot from the main, which has an elevation of 50 feet higher than the reservoir. There is no doubt, whatever, that we could supply the whole of Idle by means of the high-level service. We do not intend to supply a single inhabitant at Windhill without the consent of the local board there. I do not know that the Shipley board of health has the power to borrow money upon the security of the rents; but, if that be so, it might prevent them from becoming our consumers. The population of Shipley has greatly increased, from 3270 to 7098, but then Shipley is an exceptional case, Mr. Salt having established his works at Salt Aire, which is part of Shipley. The Halifax corporation supply places which have no other sources of supply.

Re-examined by Mr. CLABON: There is a Local Act for Shipley, and if they borrow money it must be under the provisions of that Act. The Shipley Act enables the two local boards to agree together. There is a large portion of Bradford which requires water from the high service. The high service will have as much to do as it is capable of doing in Bradford. We could not direct any of it to Idle. If the corporation should turn any of the water into Bradford Beck, it would go on to Leeds by the river Aire.

Mr. *Lott* recalled, and examined by Mr. CLERK.

The level of the township of Idle is somewhat about 500 feet above the level of the sea. The bulk of the village itself is above that level, but I have not the exact figures here of the summit of the hill on which Idle stands. I believe it would be 50 or 60 feet more. The highest part of Idle would, therefore, be about 550 feet above the level of the sea. All the levels marked upon the map are accurate. I have got a calculation of the population we propose to supply under this bill. The total population of all the townships which we sought to be added by the bill is 68,102. One of these, Bingley, has 13,249. Keighley has 8215. Shipley has 7098, and Windhill has 3000, making 42,162, to which in no case would a supply of water be given by the corporation of Bradford. We go through Huntsworth, and Gomersal, which has 11,000. That reduces the new population proposed to be supplied to 15,415. There is a limited supply from the high-level service.

Cross-examined by Mr. CALVERT: I was examined as a witness yesterday. This new light did not break in upon me during the night. Idle can be supplied from the works which now exist. The whole of the village could be supplied from the Wharfe. Some of the places proposed now to be supplied cannot be supplied from the Wharfe works. Cleckheaton can; Gomersal cannot. Hansworth cannot. Tong cannot. We can carry on our works by the line of the Lancashire and Yorkshire Railway Company from Bradford to Cleckheaton. We shall supply Gomersal from the high-level main, if practicable. We shall supply Tong and Hunsworth also from the high level. We can supply Apperley and Windhill. Some of the places I have mentioned may probably increase in population. Some of them appear to be stationary. Heatley and Cleckheaton are two most important places. Thornton increases.

Cross-examined by Mr. RICHARDS: I still unhesitatingly say, that we can supply the higher parts of Idle from the low level. The reservoir would not effect a supply to Idle, but we should require a head of water. That head will always be in the conduit. In our bill of 1858, we proposed to supply many of the villages from a high-level main. We did not then attempt to take Idle into our calculation.

John Frederick Bateman, Esq., examined by Mr. CLERK.

I have been engaged for many years past with water-works in various parts of the kingdom, and in advising corporations on the subject. I am acquainted with the supply to Bradford and its neighbourhood. I was consulted in 1852 and 1853. I then laid down a scheme for the supply of Bradford by the corporation. I am aware of the circumstances under which the works of the company were sold to the corporation. I am also aware that a certain area was appropriated to Bradford for the supply of water, on the condition of their constructing reservoirs elsewhere for the compensation of the millowners. The question of arbitration was left, and was decided by Sir William Cubitt. The reservoirs then constructed will be of great advantage to the millowners, and, indirectly, to the town of Leeds. There will be a larger quantity of water given them by the appropriation and use of the springs. The effect is to increase the volume in dry weather; and, in consequence of such advantage, all compensation by compensation-areas are of advantage to the streams. The quality of the water in dry weather will be materially improved by discharging the softer water at the compensation-reservoir. The cost of the works has been very considerable. That has arisen in a great measure because of the distance of the works from the town, and the necessity of constructing all the works before the supply was given. I have considered the proposal that the corporation should be able to sell their water on fair terms. That would be a benefit to Bradford, and a great boon to the districts which would obtain a supply. Several of the townships can now scarcely get a supply. I hardly know where they could get a supply themselves. Many of them are in coal districts; and I do not know how they could be supplied, except by the intervention of Bradford. Their streams are greatly polluted by the coal-mines in their respective neighbourhoods. Cleckheaton, and the districts north and south of Bradford, have their streams greatly polluted; and then at Pudsey and elsewhere the streams are polluted by woollen manufactories. Bradford has not increased in the last ten years in the ratio that it did in the former ten years. In 1852, the wants of Bradford were expected to be very large at the rapid rate the town was then progressing in population. I then put down the scheme at 10 million gallons, and Mr. Leather unwillingly agreed with me. But, Bradford has not progressed as it was expected it would have done. Water compensation is considered full compensation for all the streams abstracted, and that is the principle on which water compensation was given in the present case. The total quantity of water for the supply of the town is estimated, and then a fair proportion, generally one-third, is given as compensation to the millowners. I am aware that Sir William Cubitt was appointed to arbitrate on the subject. That was done under the 55th section of the Act of 1854. He determined the size of the reservoirs. In 1858, at a time when no fresh water was proposed to be taken, a clause was inserted in the bill limiting us to a minimum price for the water. I never saw a minimum price in an Act before. I saw a maximum one mentioned. That minimum price must act most prejudicially. In fact, under ordinary circumstances, it must have a prohibitory effect. Some townships would perhaps be compelled to give the price specified by the Act. There is the case of a cottage, for instance, taking perhaps 12 gallons per head per day. The water to that cottage could not be sold, under the prohibitory clause, at less than 1s., and that is tantamount to charging every cottage 20s. per head per annum. The ordinary rate for water-rent to such a cottage would be from 5s. to 10s. There is a stipulation in the Water Clauses Act, which requires companies to supply houses at 2d. a week. That is 8s. 8d a year. These two prices are quite inconsistent with one another, and yet that Act is embodied in the one for supplying Bradford with water; so that, while the corporation of Bradford would not be allowed under the Act of 1858 at less than 1s., the people under the Water Clauses Act would have a right to demand it at the rate of 2d. a week. I do not know what they charge at Halifax. In Manchester, the rate is 6d. in the pound for domestic purposes, and 3d. in the pound for public purposes, making 9d. altogether; and, in the surrounding district, it is 1s. in the pound on the rental. I cannot see how Leeds would be injured by our adopting the Water Clauses Act. Leeds cannot gain any advantage by Bradford being prevented from selling its water to the best advantage. I am told the prohibitory clause was imposed by the opposition of the Leeds corporation. If the price were rendered such that people could buy it more freely, then Bradford would take far more, and then the surplus they are entitled to would flow down the Wharfe, and they would get more than they bargained for, but then the people of Bradford could turn it into the Bradford Beck, or sell it. So far as any of the consuming districts were concerned, they would still get the advantage of the water, though it might be sold in its transit. The corporation of Leeds do not supply Cleckheaton at present. We have no right, I believe, to supply any of those places now. In Halifax, Manchester, and elsewhere, they charge as much in rates as will cover the amount of the interest on the debt. In Glasgow, the rate at present is 14d. in the pound. That upon a £10 house would be 12s. The price will vary at from 3d. to 6d. for domestic purposes. In the out-townships, where the rental of the houses is lower than it is in the town of Bradford, the water-rate would also be

lower. Supposing the quantity consumed to be the same in both cases, the house in the out-townships would pay less.

Cross-examined by Mr. CALVERT: The sources for supplying Bradford in 1852 and 1853 were the same, but the plans were different. The demand for water for manufacturing purposes is, I believe, very large now. I think Bradford will require a larger quantity of water than it has at present, and that it will go on increasing, like most manufacturing towns. I believe no compensation was given in 1854, except to the mills. The Leeds works were not in existence in 1854. If any had been in existence previously, they had been abandoned. Under the Act of 1858, the Bradford corporation could supply all the out-townships by charging 1s. per 1000 gallons. The restriction in the clause applies to supplying in bulk, and not to a restriction by the corporation. The Bradford corporation are entitled to all the water they like to take from all the appropriated areas arising from the Wharfe and the Aire.

Re-examined by Mr. CLERK: I am aware that the Leeds corporation had a pumping-station at Arthington, on Lord Harewood's property, previous to 1854. In 1852, they got permission to have a pumping-station there, so long as Lord Harewood did not object; but his lordship did object, and then the station had to be abandoned. It would be a great convenience if the corporation were to sell to the various townships in bulk, and then to allow the local boards to sell to the inhabitants. Manchester sells to Salford at the general price of 3d. per 1000 gallons. I do not know what the practice is at Liverpool. The clause of 12d., plus the expense of collection and distribution by the local boards, is virtually a prohibition, because the people would go anywhere rather than pay such a price for their water. There would be an expense of 3d. per 1000 gallons, in addition to the shilling.

By Mr. CALVERT: I believe Manchester supplies Bolton as well as Salford, and that it is sold in bulk.

Mr. CLERK stated, that this was the promoters case.

Mr. CALVERT, in addressing the committee on behalf of the corporation of Leeds, said that undoubtedly the Act of Parliament limited the purposes for which the water should be supplied to the Bradford corporation. The power of taking the water at all in the district was limited by the Act. If the committee would look at the General Act, they would find that a limitation existed, and, when they came to inspect the clauses under which these particular works were constructed, they would also discover that these works were to be for a specific and defined purpose. In point of fact, that purpose having been defined, all the powers were given, in order that that purpose might be accomplished. For instance, the 43rd section of the Act of 1854 stated that water was to be taken from the streams for the purposes of the Act. It was quite a mistake, then, to suppose, notwithstanding the evidence given by Mr. Forster yesterday, that the Bradford corporation could take all the water, and waste it if they thought proper. If they did so, there could be no doubt that an action would lie against them, because they would be taking water for other than the purposes stated in the Act; and there would, undoubtedly, be a verdict against the corporation of Bradford in such a case. The Court of Chancery would restrain them from taking it for any other purposes except those described in the Act of Parliament. This consideration would remove much of the doubt which hovered over the case, because so much water as was not required for the purposes for which Parliament had given certain powers, must be allowed to flow over the weirs, and so on to the borough of Leeds. These clauses were beneficial in their design. He admitted that whatever water was necessary for the *bonâ fide* purposes of Bradford might be taken, that whatever came within the provisions of the Act of 1858, might be taken. In 1854, the corporation of Leeds were drawing water from the Wharfe, by virtue of a contract they had with Lord Harewood. The consequence was, that it was a mistake to suppose that the Leeds corporation had in any way interfered with the Act of 1854; but, when the Act of 1858 was before the parliamentary committee, that corporation appeared, and then certain provisions were inserted, after a great deal of careful consideration and discussion. The object of the Bradford corporation in coming before the committee on the present occasion, was to repeal what had been decided by the parliamentary committee of 1858, without any change of circumstances having taken place in the interim, to justify such a departure as was now proposed, from that Act of 1858. Instead of being able to produce petitions from the out-townships in favour of the present bill, the Bradford corporation could only produce two of such petitions. Moreover, the witnesses called were witnesses in the service of that corporation; and, after all, the main object of the bill was admitted to be—the relief of the finances of the town of Bradford. Bradford had not increased in the ratio which many persons had expected, and now the existing restrictions were to be repealed, in the hope that the Bradford corporation might possess themselves of a more profitable undertaking; not, as was alleged, to confer any benefit on the outlying districts, but simply and solely to benefit the town of Bradford. Therefore, all the talk they had indulged in respecting the enormous boon they were going to confer on the districts was mere moonshine. The question was, was the proposed change to be made, not to benefit the out-townships, but to recoup the finances of the town of Bradford? The arguments used by his learned friend, Mr. Hope Scott, relative to the artisan living just outside the Bradford boundary had, therefore, no bearing whatever upon the question. The committee had been told by Mr. Bateman, and other witnesses, that there had been an emigration from Bradford; but now they were informed that that emigration had stopped, and that an increase of the population in Bradford might fairly be reckoned upon. That being so, let the committee look forward to ten years hence, and then they would find that there would be a vast increase in the manufactures and population of the borough. What, then, would be the consequence? Why, then the corporation of Bradford would come before Parliament, and say that 10 million gallons were not sufficient to meet the demand—that they would require 10 million gallons more; and thus the water of the Wharfe would be taken away, not for the supply of those living upon its banks, but for the supply of those living upon the river Aire. The committee has thus discovered the reason why the particular clause in question had been inserted in the bill. The out-townships had their own independent means of supply, and they did not want the corporation of Bradford to come in to their districts. They said, "Leave us our own present position;-we are willing to wait; and we do not ask that the corporation of Bradford shall have a sort of roving commission, for the purpose of supplying our districts, and enabling them to possess themselves of our money." Mr. Leather had stated that he would use the overplus of the water for the improvement of the sanitary condition of Bradford. That, again, afforded a key to the objects of the Bradford corporation, because the more water was sent into the out-townships, the less the corporation would have for the sanitary improvement of Bradford. When the committee were called upon to repeal clauses in the existing Acts, let them take all the circumstances into consideration which induced their predecessors in 1854 to insert them. Let them look at the interests of such important places as Leeds and Bradford, and then see that it would be a narrow view that small villages should be considered and that Leeds and Bradford should be overlooked. The object had been to show that it was not a common thing to introduce clauses of this kind into an Act of Parliament. But, Manchester had obtained authority from Parliament to supply Bolton, though it was very probable that the corporation of the former town had travelled beyond their powers. In the Halifax Act, there was no compensation clause at all. No doubt, there were peculiar clauses in the Bradford bill of 1858, but then the circumstances were peculiar. The committee had to settle this question—"Shall the district be increased?" and he contended that, inasmuch as the inhabitants of that district had not themselves come forward to ask for such increase, it would be quite monstrous to give it to Bradford. The Leeds corporation were obliged, at this moment, to go to Parliament to obtain a large additional supply of water for their increased wants, which application was opposed by landowners and millowners, on the ground that sufficient water had not been left to compensate them. The learned counsel here pointed to the rapid increase of the population of Leeds, and said that the natural supply of that town was from the river Wharfe; whereas, the natural supply of Bradford was from the Aire. It was extremely hard, when there were other modes of supply more applicable to Bradford, that the corporation of the latter town should go to the Wharfe for an unnecessarily large supply, thereby restricting the means of satisfying the imperative demands of Leeds. With respect to the outlying districts, he contended that there was already a cheap supply, which they did not wish to be interfered with; and he concluded by expressing a hope that, considering the very careful manner in which these restrictive clauses had been drawn up in 1858, the committee would hesitate very much before they consented to remove it from the Act.

Thomas Hawksley, Esq., examined by Mr. VENABLES.

I am consulting engineer to the corporation of Leeds, and constructed their works on the river Wharfe, at Arthington, in 1852. They then took the water from the Wharfe, by an agreement with the Earl of Harewood. In 1853, Lord Harewood gave notice to the corporation of Leeds to remove the works about 4 miles. They then removed to their present position. The present population of Leeds is 207,000, and about 25 gallons a day for each head would probably be the proper supply, and, in making arrangements for a further supply to Leeds, I should think we could not estimate that supply at less than 7,500,000 gallons per diem. The river Aire, on which Leeds is situated, was totally unfit for the purpose of the water supply of Leeds, mainly in consequence of the population of Bradford. The application of the Leeds corporation to take more water from the river Wharfe is resisted by the landowners, on the ground that we shall take too much of the water, and, therefore, we have a great interest in preventing others from taking an unnecessarily large quantity of that water. The minimum supply of water passing down the Wharfe in dry seasons is 20 million gallons per day, and the Leeds corporation propose to take about 4 million gallons of that water per day. In my opinion, the best water-shed which Bradford could obtain would be from the water-shed of the Aire; and, if a new and large population were to spring up, there is at present a large and unappropriated area in the neighbourhood of the Worth.

By the COMMITTEE: The storeage of the Bradford corporation would not materially diminish the flow of water in the Wharfe. Of course, eventually, some difference in the flow of the Wharfe might be the result. I remember the parliamentary contest in 1858, and I recollect that the clause which has been alluded to, and which restricts the supply to the outlying districts by the high prices charged, was inserted at the instance of the committee itself, and not at the instance of the Leeds corporation. After several of the clauses had been agreed to, the chairman said the committee had come to the conclusion to insert a clause for themselves, and restrain the corporation of Bradford from disposing of an undue quantity of water out of their own limits. The corporation had given a great deal of evidence in regard to the large quantity they required for themselves, and the committee thought that they ought to be restrained from disposing of a large quantity of water, and they accomplished their purpose by imposing a restriction as to price in such a manner as to prevent them from selling a great deal of the water.

By the CHAIRMAN: They had not particularly in their view the improvement of the sanitary condition of Bradford in coming to that decision, but it was for the purpose of preventing the Bradford corporation from becoming as it were dealers in water for other towns.

Cross-examined by Mr. PICKERING: If permission is given to the corporation of Bradford to supply the outlying districts, the necessary result will be, that the storeage-water must be increased, and I explain that in this way—If you have a storeage-reservoir, and it is always full, then all the additional water running into it would run over the weir and escape, whereas, if the reservoir were kept low, in consequence of the large supply to other towns, no water would run over that reservoir; consequently, I say, the water stored would be larger than it would be if no such extraordinary supply were given by the Bradford corporation. The water in escaping would eventually run into the Aire. I think no agreement was come to between the corporation and the water company—but the story is a curious one. The corporation were identified with the supply given by the water company, and they got up a scheme to take water from the valley of the Worth. The company thought that they ought to get up a scheme as large as the other, and they engaged Mr. Leather and myself. It came to an agreement before Parliament. The project of the corporation was abandoned, and the project of the water company was passed, but with this restriction, that the company should be obliged to sell their works to the corporation. It is a very curious story altogether. I have no reservoir on the Wharfe to compensate. We bought up the millwrights all down the stream. We compensated them all in money.

Re-examined by Mr. VENABLES: I believe that the minimum price of the water at Leeds was 6d. per 1000 gallons for trade purposes. In Manchester, the charge varies from 3d. to 2s., according to quantity; but the quantity required to be taken at the minimum price is so vast that only one person obtains it in that manner.

Edward Baines, Esq., M.P., examined by Serjeant WRANGHAM.

I reside at Leeds. I believe the population at Leeds has increased much more rapidly within the last ten years than that at Bradford. It has increased by 35,000, from 172,000 to 207,000. That would be about 25 per cent. I believe that the demand for water for manufacturing purposes has increased in a still greater ratio. I do not know that it requires now a larger quantity of water, for the same manufactures, but I know that the demand for water is much greater, and that the very same manufactures require a greater quantity of water, because they use it more liberally than they used to do. That leads me to believe that Leeds ought to have an additional supply of water over and above what it has at present, and the

corporation of Leeds are now before Parliament to obtain a greater supply. I know from personal experience that they have need of it.

Cross-examined by Mr. PICKERING: I know the supply at present at Leeds from the Wharfe. The supply at present, at Leeds, from the Wharfe, is not satisfactory. The water is of good quality, but I understand it is turbid; but that is partially in consequence of the reservoirs. They have been putting in filtering reservoirs. The water, I believe, is good in itself. Leeds is not upon the Wharfe. There are very few manufactories on the river Wharfe. There are no causes that I know of to interfere with its purity. I attribute its badness to something being done with the reservoirs. The water of the Wharfe coming from the moors is peaty. The turbid state of it is objectionable, but, there is nothing worse than peatiness. The Wharfe goes by Otley. There are manufactories there, two or three. It also goes by Burley, which has two or three mills worked by steam-power. There is a worsted-spinning concern there, and there are one or two paper-mills. The Wharfe goes by Addingham. There, there is a cotton-mill. There is a combing-mill there also, I think. A great many miles higher up, there are lead-mines. These lead-mines would be from Arthington about 25 miles or more. I do not know that the drainage of the various towns flows into the Wharfe, but I suppose it does. I cannot say the water is bad; but, chiefly from local causes within the borough of Leeds, it has become turbid. It is of a medium quality between hard and soft.

Re-examined by Serjeant WRANGHAM: The mode of shutting out fresh water from it would not improve the stream. The manufactures scattered along the banks of the stream do not, in point of fact, pollute that stream, as I have understood; but, as I said before, the turbid character of the water has arisen in consequence of the filtering-beds they have been putting down in the reservoirs.

Mr. *Hawksley* was recalled, and answered a question or two put by the chairman relative to the Washburn.

WEDNESDAY, MARCH 12.

Mr. *Philliter*, examined by Mr. VENABLES.

I am the borough surveyor of Leeds, and the resident engineer of the water-works there. Our gathering-grounds are marked upon the map. There are several places to which we went for water, and which we included in our bills, but eventually we did not go to those places to obtain our supply. When we completed our high-level water-works, we laid down our pipes to the extremities of our borough, a portion of which was in Stanningley. The inhabitants living outside the borough applied earnestly to us for a supply. We rather demurred to going outside the borough, but we eventually agreed to give them a supply. There would be about one hundred houses which applied, and we supplied about fifty. We then found that the corporation of Bradford had barred a supply to places within their limits. We were not aware until then that we were within the limits of the Bradford Act. We made a communication to the Bradford corporation, as soon as we found that to be the case. We have not supplied any other houses within the Bradford limits during that time, and have ceased purposely since then, and declared publicly that we should do nothing whatever to prejudice the interests of the Bradford corporation. I have heard Mr. Hawksley's evidence, and I agree with him in believing that, if the powers sought for under the present bill were granted, it would abstract a great deal of water from the river. There is a sluice-gate fixed, and a considerable flow of the water is regulated by the height of the sluice. The natural way of working that would be to raise the sluice-gate, for the supply of the necessities of the district; so that, in fact, the water sent to Bradford would be regulated by the wants of Bradford and its district. Much of the proposed district lies in the valley of the Aire, but that does not apply to Gomersal and Cleckheaton. I have no doubt that the necessary supply might be obtained in that way for those districts.

Cross-examined by Mr. PICKERING: I have been connected with Leeds for a period of seven years. I have been pretty well acquainted with the early history of water in that borough. There was a scheme in 1854, for bringing water from Scirfare.

The CHAIRMAN observed that this line of cross-examination seemed foreign to the object of the present bill.

Mr. PICKERING said he would not ask another question on the subject.

Cross-examination continued: In the small district already alluded to, I mentioned that we were supplying water beyond the limits of our borough. We charged for it the same price as we did in the borough. We sold it at our usual scale of rates. For a private dwelling-house, where the rental did not exceed £4 per annum, our scale of charge would be 4s. per annum. Where the rental amounted to £4, and did not amount to £20, we charged 1s. in the pound. To a smaller house, the rate would be low. A £30 house would be 20d. per 1000 gallons. There are not many houses of that class at Stanningley. I do not know the average value of the houses there, but they are generally of a low class. Assuming their average rental to be £6, and five people to the house, and twelve gallons per head—that is sixty gallons per house—the charge would be rather over 3d.—about 3¼d.

Re-examined by Mr. VENABLES: The class of houses we chiefly supply at Stanningley are workmen's cottages. They are all poor houses. In my house, the cost would be about 20d. per 1000 gallons. I should estimate roughly the average to be something like 10d.

Mr. RICHARDS addressed the committee on behalf of the Shipley local board of health, who prayed by their petition that Shipley and Windhill might be struck out of the preamble of the present bill. The Shipley Act of 1854 gave powers to Shipley to supply water; and they had it in evidence that Windhill was at present supplied with water by Shipley. The 28th section of that Act enabled Windhill to contract with Shipley for their supply. It was unnecessary to point out to the committee that, in consequence of Shipley having undertaken to supply Windhill with water, Shipley had incurred a much larger expenditure than if it had supplied Shipley alone. He cared not whether that additional expenditure had amounted to £2000 or £3000. All he argued for was, that a greater expense had been incurred because of a supply having been given to Windhill. Windhill had received an ample supply of water from Shipley, for anything which had appeared to the contrary in the evidence; except, indeed, a single passing observation on the part of Mr. Gott might be taken as testimony the other way. The Bradford corporation at the present time represented the old Bradford Water-Works Company, who, in their bill, included Shipley and Windhill; but the names of both these places had been withdrawn from that bill at the time when authority was given by Parliament to light Shipley and Windhill. From that time, 1854, Shipley and Windhill had become completely identical. The same argument which applied to Bradford, applied on a smaller scale to Shipley; because Shipley, by supplying Windhill, sought to recoup itself for the outlay it had made upon its water-works. At present, Mr. Salt was supplied by Shipley, at the rate of 4d. per 1000 gallons, but he believed the price to Windhill was 6d.; and here he might observe that there had been no petition in favour of the present bill. Mr. Gott had said, indeed, that he was inclined to think the Windhill people would be very glad to see the Bradford corporation coming to their township; and, no doubt, it was quite possible that Windhill might wish to see a ruinous competition established between Shipley and Bradford. There was a population of 3000 at Windhill, and to be deprived of giving them a supply would be ruinous to Shipley; and, if Shipley and Windhill were included in the present bill, then the Shipley water-works would be utterly destroyed.

The CHAIRMAN: Allow me to ask whether I am wrong in understanding that the promoters only wished to supply Shipley and Windhill by consent of the local boards of these places?

Mr. HOPE SCOTT replied, that this was certainly the case.

Mr. RICHARDS admitted that this had been said. Nevertheless, his clients were extremely anxious to have Shipley and Windhill struck out of the bill. They were afraid that, if they were included in the preamble, and if the Water-Works Clauses Act were incorporated in the present bill, they would be placed in an awkward position, and would find it very difficult to prevent the compulsory clauses of that Act from being carried into effect. If the promoters really did not want to supply Shipley and Windhill, what reasonable objection could there be to the striking of those two places out of the preamble? The promoters, no doubt, alleged that they would not supply Shipley without the consent of the Shipley local board, and that they would not supply Windhill without the consent of the Windhill local board; but, then, it was to be recollected that, for all practical purposes, the local board of Shipley was the local board of Windhill.

The CHAIRMAN asked what amount of money had been expended on the Shipley water-works?

Mr. RICHARDS replied, about £25,000 altogether. There were £14,000 originally, £9000 subsequently, and £2000 afterwards.

The CHAIRMAN: Are we to understand that there are no petitions from either Shipley or Windhill in favour of the present bill?

Mr. RICHARDS: That is the fact.

Mr. HOPE SCOTT replied. He said, the main contention before the committee related to the proposed extension of the limits of the promoters generally, and the terms and conditions on which they were to deal with the parties living beyond the boundaries of the borough of Bradford. There was a further contention respecting Shipley, and Shipley alone. The promoters alleged that they ought to be at liberty to supply Shipley, or Windhill, or both, with the consent of the local boards of those respective places, but not otherwise; and, although much had been said on the other side about the Act giving the supply of Shipley to Windhill, he had not heard his learned friend assert that Windhill and Shipley had actually entered into any contract.

Mr. RICHARDS believed he had made an assertion to the effect that such a contract existed.

Mr. HOPE SCOTT: For how many years?

Mr. RICHARDS: For twenty-one years.

Mr. HOPE SCOTT said he knew nothing of it. At all events, Windhill is not an objecting party on the present occasion. Shipley alone came forward; and, if Shipley should happen to become ruined, where would Windhill be? Why, then, it would be entirely in the hands of the Shipley board, who might say, "You are entirely dependent on us; you are a separate and distinct place; our first duty is to our constituents at Shipley; and you shall not have water from us unless you buy it in bulk, at such prices as we choose to ask." Suppose manufactories were to spring up at Windhill, were they to be kept without water if Shipley either could not or would not give it? Now, the promoters proposed to give the people of these two places the option of taking water from Bradford. If the alleged contract really existed, then let the people have the option at the expiration of the twenty-one years of coming to Bradford for their water. The balance of evidence was so distinctly in favour of allowing the powers to remain in the bill that he could hardly think it possible the committee would exclude those two places from the operation of the provisions of the measure. He now turned to the larger question of selling water in bulk. They had now the evidence of Mr. Hawksley, who denied that the clause in the bill of 1858 had been inserted at the instance of Leeds, and who said it was introduced spontaneously by the committee. He (Mr. Hope Scott) had opened the case under the impression that it had been inserted at the instance of Leeds; but now it appeared that he was in error. If that were so, the whole question was clear. He represented a population within the borough boundary, who entertained no apprehension, and who were interested in the repeal of the prohibitory clause. The price at which they were obliged to sell in bulk under that clause amounted to a downright prohibition. It would be 23s. 6d. a year to an ordinary cottage; whereas, according to the Health of Towns Act, it ought only to amount to 8s. 8d. The mode, therefore, at which the promoters could afford to sell at, the people could not afford to buy at; and the mode the people could afford to buy at, the promoters could not afford to sell at. Hence, the promoters wanted to get rid of this anomalous state of things; and nobody was petitioning against them. Where, then, was the opposition? Leeds disclaimed having put in the clause; but, still, Leeds wanted to hamper Bradford by saying that it would want more water. The answer of Bradford, on the other hand, was, that that borough would also want more water. Then, the corporation of Leeds alleged that they were first in the valley of the Wharfe; to which Bradford responded that they were not first in the valley of the Wharfe, except for some temporary purpose. It was not denied that Bradford had the power to take all the water. What, then, was it to Leeds, or to anybody, if Bradford took it, and sold it? Was it not the case of the dog in the manger, seeing that Leeds could not get the water if Bradford did not sell it? He hoped, under such circumstances, that the committee would allow the promoters to turn the water to a profitable and useful purpose. Their conduit was equal to taking all the water which, by the Act of 1854, they were empowered to take, and they would take it all. What were they to do with it? The Act of 1854 said they were to supply the borough of Bradford, and the out-districts. The Act of 1858 contained the prohibitory clause, and the inhabitants and promoters asked for the repeal of that clause. If it had operated in favour of Leeds, it had done so undesignedly and accidentally. The promoters were not seeking to be allowed to take one drop more of water than they could take at present; but they were asking for permission to sell some of it to parties who were willing to take it from them. They were asking to be dealt with as Parliament had already dealt with Halifax. Strong petitions in favour of the bill had been received from Tong, Cleckheaton, and Idle; and, if there were any people desirous of not taking the water from Bradford, the promoters did not want to force a supply upon them. In a word, they only sought to utilize their supply, and to diminish a burthen which now fell heavily on the shoulders of the ratepayers of Bradford. He asked the committee, then, to pass the preamble of the bill as it stood; at the

same time, they could, if they liked, say that there should be a separate bill respecting Shipley and Windhill.

The room was cleared, and, on the re-admission of the public,

The CHAIRMAN said: The committee are all of opinion that the preamble is proved.

The PARLIAMENTARY AGENT then proceeded to read through the several clauses, with the proposed additions and alterations.

Clauses 1 and 2 were passed without alteration. On clause 3 being read,

Mr. RICHARDS renewed his application to have Shipley and Windhill struck out of this clause.

The room was again cleared. On our readmission,

The CHAIRMAN said: The committee have come to the conclusion that Shipley and Windhill shall not be struck out of the clause.

Mr. CALVERT: Is it the intention of the committee to include within the Bradford district all the places named in clause 3?

The CHAIRMAN: Yes.

Mr. CALVERT: Then, we now propose that the same clause which was in the Act of 1858, shall be inserted in this bill—namely, the prohibitory clause.

The CHAIRMAN: We shall save you the trouble of arguing upon that point, by stating at once that the committee have agreed to repeal that clause.

Mr. RICHARDS: We say that, inasmuch as Shipley and Windhill are practically one place, the promoters should not be allowed to supply either Shipley or Windhill without the consent of the Shipley Local Board of Health.

Mr. ST. AUBYN: When will the contract for the 21 years expire?

Mr. RICHARDS: That contract will expire in about 17 years from this time. It is a binding contract for 21 years.

The CHAIRMAN: So far as we consistently can, we are willing to protect Shipley; but it will not do that Shipley should for ever hold her powers over Windhill.

Mr. PICKERING: We do not seek to interfere with the terms of the contract, whatever those terms may be.

The CHAIRMAN: We are willing to put in a saving clause, in the usual form, to protect the rights of Shipley.

The remaining clauses of the bill were then agreed to.

UTILIZATION OF SEWAGE OF TOWNS.

MONDAY, MARCH 22.

The select committee appointed to consider the question of the utilization of the sewage of towns, met for the first time this day. The committee consists of the following members:—Dr. Brady (chairman), Mr. Adderley, Mr. Adeane, Mr. Ayrton, Mr. Blencowe, Mr. Bristow, Mr. Du Cane, Colonel Fane, Mr. Gregson, Viscount Holmesdale, Mr. Gore Langton, Mr. Paget, Mr. Roupell, Sir F. Smith, and Mr. Whitbread.

The Earl of *Essex*, examined by the CHAIRMAN.

I use the sewage of the town of Watford for the purpose of irrigating my land. When I first took it, I believed that there was sufficient sewage to irrigate 210 acres, and I under-piped that quantity of land, thereby committing a most egregious error. The utmost extent to which the sewage of Watford should be applied is from 60 to 80 acres. As I had a great opinion of the efficacy of sewage, and the Board of Health at Watford were in a fix as to the mode of getting rid of it, they offered it to me at a low rent. I believe they were so troubled with it, that they would have given it to me for nothing. The population of Watford, from which I take it, is about 4000. The crops to which I have chiefly and practically applied sewage are Italian rye-grass. I have tried it experimentally with wheat. I have applied it, with the utmost success, to mangel-wurzel and roots in general, and also with success to a portion of meadow-grass. On 7 acres of Italian rye-grass so irrigated, I have fattened 13 bullocks, and kept 7 or 8 horses and ponies, with an indefinite number of pigs to eat up the refuse. With regard to wheat I tried the experiment, because it was always supposed that the effect of sewage irrigation was to increase the quantity of straw, and not the quantity of corn. The result of my experiment, which was made upon a small portion of land, was, that the increased value, both in corn and in straw, was £2. 7s. 6d. per acre net profit, after deducting the charge for the sewage. Having entered into this matter as a pioneer, I committed many errors, and I have no hesitation in saying that, from one bungle and another, the cost has been to me double that which it ought to have been. My experiment with wheat was upon 2 acres of land, comparing it with 2 acres of precisely similar land unsewaged, and the £2. 7s. 6d. was the net-profit result of the working. I only did it to prove whether sewage would do for wheat. I did not apply any other manure to the land. As near as I can calculate, I get about 60,000 gallons of sewage per day, which is about 270 or 280 tons, and that I put upon my land. Taking an average of five working days a week, I get about 80,000 tons a year, and I estimate the cost to me, with all my unnecessary expenditure, at something like 1d. or 1¼d. per ton. I think my own operations are not a suc cess, commercially speaking. I am quite convinced that, if the sewage can be obtained at three farthings per ton, it might be advantageously worked; and, if at one halfpenny, it would pay uncommonly well. If I had not made any unnecessary outlay in the first instance, my operations would have been a perfect success. I paid £1000 for main-pipes laid down in the land, a great portion of which are doing nothing, simply from my having miscalculated the quantity of sewage. In very hot weather, if sewage is applied as a top dressing to land, evaporation takes place; but, in wet weather, I do not think it signifies, because that which is likely to evaporate is soon washed down into the soil. I do not think any loss in value by evaporation takes place if the sewage is prudently applied. If the land itself is suitable for sewage—that is to say, tolerably porous—it sinks at once into the soil. My observation has shown me most decidedly that sewage manure has a permanent influence upon the land. After having had a certain portion of land sown with rye-grass—for two seasons under sewage, and, consequently, well swashed with it—I can trace its influence distinctly, and see the effect in two or three months. I firmly believe that the productive value of land is increased by a continuous course of sewage irrigation—I conceive it is permanently benefited by it. I have never tried guano side by side with sewage. Every one knows that guano can only be applied in moist weather; it is perfectly useless in dry I have not tried it sufficiently as to be able to judge whether it has such a permanent influence on land as sewage. The operation of sewage irrigation has been carried on near my house. Of course, in the immediate application of it to the land, there is more or less of offensive smell, but that is obviated in a great measure by distributing it near to the ground. Once in the soil, and five minutes afterwards there is not the slightest effect. The men employed to put the sewage on the land have never in the slightest degree suffered in health. I have had the same men during the whole season at work eight or ten hours a day, and I never heard any complaint from them.

The CHAIRMAN: From the results obtained, are you led to think that your land would be much increased in value if a scheme were devised by which you could obtain a constant supply of sewage?

Witness: Most decidedly. I think there can be no doubt of the value intrinsically of sewage.

The CHAIRMAN: I believe you were the chairman of the Royal Commission appointed in 1857 to inquire into the best mode of disposing of the sewage of towns?

Witness: I was.

The CHAIRMAN: I hold in my hand a proof of the report of that Commission; and I find at page 22 these remarks: "We now proceed to the consideration of that method of disposing of the sewage of towns which we believe to be in every respect the most complete and beneficial where circumstances are favourable—viz., its direct application to the land in a liquid form. It is matter of regret that so little progress has been made in the utilization of liquid sewage in this way since the period of our previous report"—that is the report of 1858. Now, my lord, you quite agree with the view thus expressed in the report?

Witness: Yes; it is a great pity it has not been done.

The CHAIRMAN: I also find here, "We have no doubt whatever that the direct application of sewage in a liquid form to land, if properly conducted, would solve the difficulty of the drainage in many towns, and in some would be attended with profitable results."

Witness: I think so; that is, it would pay any expense of getting rid of it.

By Mr. ADDERLEY: As I have only sewage enough for a very small portion of the land, I keep it for the part which is nearest the tank. I apply it to about 10 acres of Italian rye-grass, and 35 acres of meadow-grass, every year, and to a little wheat and clover. I put on from 60,000 to 80,000 gallons per day, which is about 6000 tons per acre annually. The rest of the sewage I have is applied to roots, &c. I certainly think the quantity I have is not more than enough for about 50 acres of land. With meadow-grass, you do not require so much as with Italian rye-grass. I have made no calculation as to the increased profit arising from its use with rye-grass. I cannot give any idea of the number of cattle which could have been fed upon the land per acre before the application of the sewage. I should say for all artificial grasses sewage manure would be most beneficial. The pipes distribute the liquid and solid sewage together. There is an agitator in the tanks which keeps it in a state of ebullition, and prevents its settling, and it is pumped on the land in a sort of semi-fluid state. What goes on is the whole of the sewage matter of the town, including the refuse from slaughter-houses, &c. I believe the ammonia in the sewage is greatly in excess of the phosphorus, which can only be supplied artificially. This sewage has not been scientifically analyzed. There are no manufactories in Watford. I think if guano were put on the land in a liquid state, so large a quantity would not be required; but it is very expensive. The farmers in the neighbourhood have no opportunity for trying the effect of sewage upon their land, as I take the whole of it; they have seen the results on my farm.

By Mr. AYRTON: The distance of the town from the place where the sewage is employed is about a quarter of a mile. The sewage is conveyed in close pipes underground. In ordinary circumstances, the surface water goes into my tanks; but, when there is a heavy downfal of rain, I have the means of shutting off the flood waters altogether—*i. e.* I allow the rain at the commencement of the shower to run into the tanks so as to flush the drains, and then I close the entrance, and the waters go off into the stream. I have no idea as to the extent of the area of drainage at Watford. I cannot tell the exact increased value of the 50 acres to which the sewage is applied; I can only speak to their generally improved character.

By Sir F. SMITH: The tanks were put down by the Board of Health, and I pay interest on the outlay. The person who attends to the shutting off of the rainfall is the engineer who has the entire charge of the tanks.

By Mr. GREGSON: If I had a sufficient supply, I should use the sewage for my wheat crops with great confidence, and especially I should apply it to roots. I think the quantity I have given is the proportionate quantity to the population which would range generally.

By Colonel FANE: The size of the sewer is about 3 feet in diameter. One great error I committed was, that I did not put down a pipe sufficiently large; the engine was also too small. Had the pipe been larger, instead of 60,000 gallons a day, I might have had 100,000.

By Mr. BRISTOW: I do not mean to say that the effect of sewage is more permanent than that of guano; they have pretty well the same ingredients. I have here a paper which shows the results of its application. The sewaged land gave, of straw, per acre, 5 loads, and of wheat, 53 bushels; the unsewaged gave 4¾ loads of straw, and 44 bushels of wheat per acre. The value of the crop on the sewaged land was £23. 10s, and of the unsewaged, £20. 8s. 6d., the difference being £3. 1s. 6d. in favour of the former. The cost of the sewage per acre—30,000 gallons, or 134 tons—I put, at five farthings per ton, 14s.; leaving the clear gain on the sewaged land, £2. 7s. 6d. I have never seen the outflow from sewaged land, but I believe all the manurial value is absorbed by the soil.

By Mr. ADDERLEY: The application of the sewage to wheat was made early in March, the season being favourable. The soil was good loam upon gravel; it was not tile-drained.

By Mr. GREGSON: It is entirely an engineering question, which I cannot answer, as to how the sewage could be best transported from towns at a considerable distance from the place where it is desired to apply it—as from London to farms in Essex; but, as to the intrinsic and absolute value of the sewage, I think there can be no doubt.

Mr. ADDERLEY: 60,00 tons at 1d. per ton would be £25. Is that what you calculate the cost to you?

Witness: Less than that for the meadow land, and more for the Italian rye-grass.

Mr. ADDERLEY: Have you formed any opinion as to the value of sewage when precipitated by lime?

Witness: No; I have not.

The CHAIRMAN: I think the question is an important one, as in the report of the early Commission it is shown that 4/5ths are precipitated, and 1/5th only remains.

Dr. *R. Angus Smith*, examined by the CHAIRMAN.

I have studied the question of sewage utilization in some aspects for more than fourteen years. I have observed what has been done in Paris, Milan, and parts of Germany, with reference to the subject, but I have seen nothing very favourable abroad. I have made no experiments there. My most complete examination of sewage was at Carlisle. There I had two specimens taken from the outlet of the sewer just below the town. I found that the sewage flowing during the night was scarcely to be called sewage—it was almost pure water, and even at the best, the sewage there

was very poor. The amount of ammonia contained in it was seldom above 1½ grain per gallon. I believe in London it has been found to rise up to 7 grains per gallon, although, even in London, the variation is very great. But notwithstanding the quantity of ammonia in the sewage of Carlisle was very small, the effects produced by putting it upon the land have been very decided. I consider that the amount of ammonia in sewage very fairly characterizes its value, supposing there is a proportionate quantity of phosphoric acid. The other matters in it have little or no effect.

The CHAIRMAN: Do you mean to say that the soda, potash, and metallic oxides have no effect upon the sewage?

Witness: Yes; they all have their effect, but, I think, we generally find a very constant proportion along with the ammonia and phosphoric acid. We must suppose that proportion will continue the same; and, if we characterize this sewage by 1 grain of ammonia, and another by 6 grains, we get, as a general rule, a distinct character. I suppose between 1 grain, and 6 or 7 grains, we might characterize all the sewage of England. I have not taken the amount of ammonia in other sewage than that of Carlisle. It seems to me that the question of the application of sewage is not an agricultural question entirely. I have examined it more in a sanitary point of view.

The CHAIRMAN: That is a question we have nothing at all to do with at present. You said that you have examined other sewage than that at Carlisle, but have not ascertained the quantity of ammonia it contained. What led you to examine it?

Witness: Nearly all my inquiries relate to the effect which manure on the ground has upon the atmosphere, and also in the sewers, and as it flows out of the sewers—the general sanitary bearings of the subject—the effect of air upon sewage, and the effect of air upon soil. I have made no analysis of sewage for myself.

The CHAIRMAN: Can you inform the committee the per centage of solid matter contained in sewage—the relative proportion in various localities?

Witness: Sewage has been found in London with something like 300 or 400 grains of solid matter in a gallon. The sewage of Carlisle has very much less—some as little as 5 grains in a gallon; so that there is an enormous difference.

The CHAIRMAN: I suppose you are aware that in Leicester, there is one ton of solid to 700 of liquid matter?

Witness: I have seen it so stated.

The CHAIRMAN: You are aware that Professor Way says he found 1 grain of solid matter in every 142 grains in his experiments in Barrett's Court, and 1 in 334 in Dorset Square?

Witness: It is the general opinion that there are from 6 to 7 grains of ammonia in a gallon. The solid matter may be of no value; it may be a great nuisance. I cannot say whether the surface drainage of towns has any manurial properties.

The CHAIRMAN: Is it in your experience that sewage applied to land produces anything like the typhus fever, or that it increases epidemic disease?

Witness: It is difficult to prove that any disease is caused by it; but it is very easy to prove that there are emanations from land which is covered with sewage. It is quite true that the soil absorbs the impure matter with avidity; but there is still a considerable amount left on the surface when the land is deeply manured, and there is always a certain quantity left on the grass and vegetation, which, of course, must have its effect. The organic matter in sewage-water begins to be oxidized, and evolve carbonic acid, and other matters, immediately on its escape from the sewer; and the decay of the manurial properties is exceedingly rapid, also. Sewage-water, therefore, is a substance which will not preserve long; it must be used immediately. I have made experiments upon the action of air upon organic matter, and it may be traced very readily. Even in fœtid water, the effect is very rapid. Whenever the temperature rises above 54°, the oxidation is intensely rapid. I conceive it is an important thing to prevent this—first, for the sake of health; and, next, to prevent the loss of the manurial property of the sewage.

By Mr. AYRTON: The sewers should be so constructed as not to allow of the loss of the fertilizing properties of the sewage. Before coming to that, I want to explain in what manner the loss is effected. I have found, in my experiments, that the whole substance is rapidly undergoing decomposition. This can only be prevented by using a disinfectant agent for the purpose. There are many disinfecting agents used which operate, some by precipitation, and some otherwise. That which I have found the most efficient is carbolic acid or creosote. When put into sewage-water, the sulphuretted hydrogen which it contains ceases to escape. I am not aware that there is any new element formed by it; it simply prevents the action of oxidation going on, and putrefaction taking place. It acts in rather a mysterious way.

The CHAIRMAN: Can you give us any information as to the application of sewage to agriculture, and what effect it has upon crops?

Witness: I have simply attended to the sanitary matter, and had nothing to do with agricultural results.

The CHAIRMAN: Do you consider the evaporations from sewage contained in open gutters to be dangerous to health, and likely to cause malaria?

Witness: Yes; that is a nuisance with which the whole country is contending. There is a constant evaporation from the surface not only of water, but of impure matter.

Examination continued: As a general rule, I should think that several applications of sewage-water of lesser strength would be more calculated to promote the growth of plants than a single application of strong or solid sewage. The fibrous matter contained in sewage is not taken up by the roots of plants. The amount of dilution, therefore, is no reason, in an agricultural point of view, why sewage should not be used as a manure.

The CHAIRMAN: Have you made any experiments as to the relative effect upon crops of different manures? In connexion with that question, I wish to draw your attention to a report of the Board of Health published in 1852, in which Professor Schubler, speaking of manures, says, if a given quantity of land sown without manure yields three times the seed employed, then the same quantity of land will produce five times the quantity, some when manured with old herbage, putrid grass or leaves, garden stuff, &c., seven times the quantity of seed sown if manured with cow-dung; nine times, if manured with pigeons dung; ten times with horses dung; twelve times, with human urine; twelve times with goats; twelve times with sheeps; and fourteen times with human manure or bullocks blood. Do you agree in that opinion of Professor Shubler's?

Witness: It agrees very well with what is generally considered the value of manure.

The CHAIRMAN: In your experience, do the roots of plants possess and exercise a selecting power in the choice of food?

Witness: I think they do—sometimes more than at other times. They have the power of absorbing, without injury to themselves, the weak solutions of different poisons found in the sewage of towns—more especially manufacturing towns. There has been no case recorded of injury to the plants. I have not found that the colouring matters discharged from dye-works into the sewers are injurious to the health of plants. These matters are used a great deal in Lancashire. They consist principally of logwood, indigo, and woad, and these are not at all objectionable in an agricultural point of view.

The CHAIRMAN: Will you tell the committee what changes take place in the water or sewage which percolates through the soil where it is employed?

Witness: If the drainage is pretty deep, something like 4 feet, or not less; almost all the organic matter is absorbed, and perhaps not more than one grain in a gallon remains.

The CHAIRMAN: Do you mean to say that the grain is a grain of organic, or fibrous matter?

Witness: Organic matter in clear solution. If the soil is good, the earth will absorb the manurial properties as they pass through.

The CHAIRMAN: Do you think that the drainage of land and a proper supply of sewage would compensate for the deficiency of solar heat in ripening plants?

Witness: That is a question which I cannot answer. It will promote their growth.

The CHAIRMAN: Is it not generally acknowledged that the great difficulties which a farmer has to contend against are the excess and deficiency of moisture and the deficiency of heat, and that these three great difficulties would be in some measure compensated by drainage and the proper use of sewage?

Witness: Two of them, certainly; and, to a considerable extent, the third.

Cross-examination continued: I believe it to be true that irrigated land by water, such as catch-water, produces tissues of soft and spongy matters, and with a less amount of siliceous deposit than similar land irrigated by sewage. I have seen great numbers of cattle fed upon land treated with sewage, and know that they have been fed with advantage to the owners, and with health to themselves. I know that they are exceedingly fond of grazing on land which has been manured with sewage, and that they thrive well. I have seen them grazing on the morning after the sewage has been applied to the land. I cannot tell the comparative value of the fibrous and solid matter in farmyard dung and the liquid which flows away. It is well known that the serious loss sustained by farmers is by allowing the liquid portion of the manure to pass away. The solid dung from the yard requires a year, and sometimes more, before perfect decomposition takes place in the ground, and its entire productive qualities can be absorbed and taken up. The same amount of manure in a liquid form would come into action instantly, and is very rapidly reproductive—hence, a great advantage in its application. I have been at the Edinburgh meadows. I have heard that as much as 8490 tons of sewage, to the depth of 6·9 feet, is annually placed on each acre there. I know the locality; it is pretty well supplied with water. I have never analyzed the sewage there, nor seen it analyzed.

The CHAIRMAN: Are you aware that the sewage of London has been valued by Professor Hofmann at 2d. per ton?

Witness: I remember he made something like £1,500,000 of total value.

The CHAIRMAN: Have you ever taken into consideration the value of a ton of liquid manure?

Witness: I have taken into consideration the value of the whole of the London sewage, and come to a conclusion almost the same as Professor Hofmann—viz., £1,450,000 per annum. I should consider the sewage of Edinburgh a little more valuable, because the supply of water is not quite so abundant. The 8490 tons of sewage applied to the Craigentinny meadows at 2d. per ton, would cost upwards of £70. The rent received for those meadows is £60 per acre. It would not, therefore, be at that rate a commercial success; but the proprietors pay nothing at all for the sewage.

By Mr. ADDERLEY: The quality of sewage varies according to the description of manufacture carried on in the particular town; but I do not think that would be a very important element in the consideration, because the most injurious elements which could get into it are strong chemical agents, which are too expensive to throw away, and are preserved as much as possible. In the use of phenic acid for the purpose of preventing decomposition, if taken in great excess, it would destroy the manurial properties of the sewage. Phenic acid is used in the sewage at Carlisle, and found advantageous. The effect of the use of lime is to throw down all the flocculent matter, and all the phosphoric acid; but it cannot throw down any of the soluble salts, such as ammonia, potash, soda, &c. I think the use of lime is injurious in an agricultural point of view; but, in a sanitary point of view, I think the sewage is better if treated with lime.

Mr. ADDERLEY: But, ammonia being a great conveyor of noxious vapours, is it not therefore clear that the treatment of sewage with lime is injurious to health *pro tanto*?

Witness: It would be so if the manure were only ammonia, but, it is a collection of organic substances, some of which are capable of producing ammonia. These substances are thrown down by the lime, and the chemical action is arrested in the sewage. I conceive, therefore, that the liquid after being treated with it gives off less objectionable matter than before.

By Mr. AYRTON: The sewage of Carlisle is utilized in the neighbourhood. The land is situated immediately where the town ceases both ways. After it leaves the town, it is conveyed in open channels. The rainfall is mixed with it. The carbolic acid is used at the exit of the sewer, and the beginning of the fields. There are no close pipes; it is open irrigation, and the carbolic acid is mixed with the sewage at the point where the irrigation begins. It is employed to prevent decomposition; there is no smell at all. I am not prepared to furnish the results of the irrigation. The use of carbolic acid has been tried at Leicester. The sewage there is not all used on the land, and the carbolic acid is employed to prevent the sewage being injurious to the river. It is also used at Croydon. I have not the results, but I know they are favourable. It has also been tried at one or two asylums. I think the carbolic acid mixed with the sewage would preserve its fertilizing properties for years. The Egyptian mummies furnish an instance of the preservation of organic matter by carbolic acid. Without its use, sewage begins to decompose instantly, supposing the temperature to rise above 54°. It is much more rapid in running water than standing. I think it would not lose its fertilizing properties in running through a culvert for 5 or 6 miles, not quite full. If it ran for 10 miles in an open channel, there would be a great assimilation of particles, and a great deal of mud would form at the bottom, which would contain the principal part of the manure. In the course of 20 miles, it would be very much diminished in value, and at the end of 30 miles you would scarcely perceive any effect. It would be better than ordinary river-water for irrigation. I should not be surprised if the loss of fertilizing property

were greater than 75 per cent. The difference would not be very great, whether it ran in an open or close channel, supposing the latter were not full; but, there would be a difference if it ran in a close pipe completely full; it might be preserved considerably longer. At Milan, the effluvia did not extend more than a quarter of a mile from the place where the irrigation was carried on. It is difficult to say what is safe, and what is not safe. There is a canal near Manchester which receives sewage from a portion of the town. The water has an exceedingly offensive smell. The people living on the banks say they are in perfect health, and not at all injured by it, but it is a remarkable fact that they cannot keep meat above a day; they are obliged to use it at once. No doubt, it must be very injurious to health. I think the application of sewage to land is injurious, if the gases are permitted to escape. If the land were properly drained, that would diminish the mischief. When the sewage is thoroughly mixed up with the soil or clay, it is thoroughly disinfected, but it takes some time to be thoroughly absorbed by the soil. To remedy the evil, from the emanation of sewage matter, has been one of the objects of the Sanitary Commission for years.

The CHAIRMAN: Do you agree with Professor Way, that sewage after five minutes application is perfectly disinfected.

Witness: I have never seen it. I believe it would be perfectly true if put upon ploughed land; but, if put upon grass-land, the mixture with the soil is not so rapid.

The CHAIRMAN: Is it not to your own knowledge that the sewage of towns, before it comes to the outlet, or before it has become analyzed by you, or applied to land is, in a state of decomposition, of the most perfect character?

Witness: Very frequently; unless it is taken up with intense rapidity.

The CHAIRMAN: In that case, being completely decomposed, there is no use in applying any gas, such as carbolic acid, to preserve it?

Witness: Well, I should say yes; it would prevent decomposition going further.

The CHAIRMAN: But, if entire disintegration has taken place, do you think there would be any good in applying carbolic acid?

Witness: I do not say where entire disintegration has taken place, but where the process is in action. If it stands in a pool or sewer, decomposition may be begun, and it may be completed before it leaves the town, or where cesspools are in use. The presence of smell is always a proof of the existence of noxious matters; but its absence is not a proof of their non-existence.

THURSDAY, MARCH 27.

J. B. Lawes, Esq., examined by the CHAIRMAN.

I was one of the royal commissioners appointed in 1857 to inquire into the best method of utilizing the sewage of towns, and applying it to profitable uses.

The CHAIRMAN: We understood from the examination of Lord Essex, who was chairman of that commission, that you had been experimenting with sewage for some time. Will you inform the committee in what manner you did so, the manurial value of sewage as compared with other manures, and the results of your experiments as regards crops?

Witness: The experiments which I have made have been upon 15 acres of grass-land at Rugby, and the quantity of sewage employed was in the proportion of 3000, 6000, and 9000 tons per acre. The sewage was pumped up to the top of the fields, and gauged as it ran over by a large tank holding three tons, so that the exact quantity was ascertained by measurement. It was not applied every day, because there was a full demand for the sewage, and we took it as we could get it, during one, two, or three days a week. One day an acre in each field was left without any sewage whatever; and the product was mown as required, green and wet. It was then taken away into feeding-sheds, one of which was devoted to the feeding of oxen, and the other to cows only. We were not able last year to get on so much as we calculated, so perhaps I had better read out the absolute quantities put upon each acre. We commenced in March, and continued the experiments to the end of October, at intervals. The absolute quantities per acre were 1500, 1900, 3000, 4700, 4800, and 6700 tons, which latter was the largest quantity we employed. The product with the 1500 tons of sewage was 15 tons 6 cwt. of grass; with 1900 tons, it was 14 tons 6 cwt.; with 3000 tons, 22 tons 15 cwt.: with 4700 tons, 26 tons 13 cwt.; with 4800 tons, 27 tons 1 cwt.; and with 6700 tons, 32 tons 17 cwt. of grass. These were the results obtained in two separate fields, a mile apart, the land of each being probably of equal value, but one field sloping more than the other. The sloping land was a little less profitable, on account of the sewage passing off. The land is completely drained, according to the modern system, and the whole of the sewage was poured upon it. The increase of product of grass per 1000 tons of sewage was as follows:—With the smallest quantity per acre it was 4 tons 12 cwt.; with 1900 tons, 4 tons 12 cwt. of grass; with 3000 tons, 4 tons 8 cwt. of grass; with 4700 tons, 3 tons 16 cwt. of grass; with 4800 tons, 3 tons 14 cwt. of grass; and with 6700 tons, 3 tons 10 cwt. These were the weights in green grass, as cut off to feed cattle. From these experiments, I should not be led to think that the products do not increase in the ratio of the quantity of sewage applied. I cannot tell the value of the sewage per ton; that would depend upon arbitrary circumstances. The grass would not fatten oxen when used alone. The course we adopted was that of irrigation according to the Edinburgh system; and the only cost was that of pumping up the sewage and preserving the irrigating channels in good order. The amount of solid manurial matter contained in the sewage was a little more than 1 in 1000; each 1000 tons contained the excrementitious matter of 26 people. The theoretical value of each individual is about 6s. per annum. I think that is the highest value I have known to be put upon it.

The CHAIRMAN: To enable you to form a correct idea of the relative value of sewage as compared with other manures, it would be necessary that simultaneous and contemporaneous experiments should be carried on, with land of exactly the same character, and with the same amount of the different manures diluted with the same bulk of water which is found in the sewage experimented upon?

Witness: I do not think so; I do not think it would teach me anything.

Examination continued: You cannot compare solid manure with sewage. You could produce an artificial sewage by diluting the solid manure with water. I have never done so. As near as I can tell, the value of the sewage at Rugby would be about 7s. per ton to produce it dry, and sell it in a powdered state. I do not think it would be a judicious expenditure, and likely to be a commercial success, to apply the same amount of guano in value to land as of sewage. It might be advisable to use guano or other dry manures with sewage, if you get rid of the question of cost altogether. I think it is quite unfit, diluted as it is with so much water, to use it with farm-yard manure. We have already too much water on the land. The effect would be to lessen the amount of dilution; but farm-yard manure is itself very diluted by the urine of the animals. I am a manufacturer of manures for turnips and other green crops, but not for grass.

By Mr. BRISTOW: I have not tried experiments anywhere else with sewage than at Rugby. My opinion is, that sewage is not a manure of universal applicability. I think it is not applicable to corn, as it cannot be used all the year round. I do not consider that it is where the manurial substances in the soil are deficient that it is applicable; it is the crop, and not the soil, which makes it available or not. The theoretical value of sewage at 6s. per head is its value if dried and sold as guano. My experiments at Rugby lead me to value it at 2s. or 3s., estimating it by the product obtained in milk—mowing the grass, and feeding the cows upon it, without any other food. At 6s. per head, the value of 1000 tons would be £7. 16s., considering that 26 people supplied it in the course of a year. The solid matter is 2400 lbs. in 1000 tons, which is equal to about 78 grains in a gallon. London sewage contains about the same quantity: 90 grains was Dr. Letheby's estimate. I am sure that, in a commercial point of view, the manufacture of solid manure from sewage residuum would not be successful.

By Mr. BLENCOWE: I do not think you would obtain a scientific result, in comparing sewage with other manures, by applying a certain amount of it to the land in the ordinary way. You would get some general knowledge, but it would not be very correct. The sewage we used at Rugby was fresh; I should think we got it within a day or two of its being produced. In summer time, there is considerable smell from the tank, because there is always a great deposit of fermented matter at the bottom, as it is not pumped dry. The smell is not perceptible at any considerable distance: perhaps, in very hot weather, it extends a quarter of a mile. The fields in which we experimented were laid out by Mr. Beckford on what is called the contour system—a series of small furrows. The sewage is run through these trenches, and trickles over the surface of the soil. I should think, as a general rule, that by the time the water leaves the land at the bottom of the field, the organic matter was completely taken out of it, and it might enter the river without affecting its sanitary condition, but I cannot speak definitely on this point now; next year, we shall go into that question. I have seen the experiments at Leicester, of precipitating the solid matter in the sewage by lime. I think, after precipitation, the greater part of the value of the sewage is still in the liquid. We left an acre of land in each field without sewage. The average yield of milk per day from a cow fed on that land was 25 lbs., and on that which was treated with sewage it was 20½. In each case, the cow had as much as she wished to eat, but it is exceedingly difficult to get two or three cows which will do as an average for all the rest; therefore, there is not much value in this experiment. You never can determine the value of an experiment by changing the food of an animal. I have only made my experiments at Rugby during one year.

By Colonel FANE: I do not say that sewage is only suitable for grass, but I think grass-land is the proper land on which to apply it. The great difficulty in applying sewage to roots is, that during a great portion of the year you cannot put it on the land. I cannot give an idea of what the whole 15 acres at Rugby cost in sewage last year; I have not looked into it. It would be no information if I could, because it was a mere matter of bargain for the experiment. The grass was kept continually cut, and the cattle fed well off of it the same day. No animal was fed on the land; the grass was mown, and the cattle fed in sheds.

By Mr. AYRTON: The experiments were conducted at the public expense by the royal commission. I cannot tell the area of drainage at Rugby which comes into the outfalls. The sewage comes from the town in an open channel, the length of which to the outfall is about three-quarters of a mile; and the distance from the tank to the field in which the experiments were made about half a mile, along which it is conducted in an iron pipe. Part of one of the fields in which I experimented had been sewaged before. No comparison has been made there between sewage irrigation and ordinary irrigation. I am not able to inform the committee how much of the improved condition is due to the fertilizing properties of the sewage, and how much to irrigation. I could get £30 or £40 an acre for the meadows when sewaged, and perhaps only £6 or £7 if simply irrigated. I do not think the nature of the soil would have to be taken into consideration in using the sewage to the extent I do, if there were proper drainage. I should prefer a sandy soil, certainly. In Edinburgh, it is sandy. In order to make a comparison between manure and sewage, it would be necessary that the former should be as finely comminuted as the manurial properties of the latter. It is a maxim in manuring that the manure should be as fine and be spread as evenly over the field as possible. My estimate of the produce of sewaged land is, that it is good for feeding milch-cows in stalls, but not for fattening stock. It would not be well for feeding cattle on the land. The produce of one acre, unsewaged and without any manure at all, fed one cow for 20 weeks. The year before that acre had been irrigated. The number of weeks during which a cow was fed from the sewaged land in one experiment, with the smallest quantity of sewage per acre, was 40; with the next larger quantity, 58; and with the next 68 weeks.

By Lord HOLMESDALE: The preparation of sewage into a solid manure would not answer, because the value of sewage remains in the liquid. The value of the produce in milk of the unmanured land was £11. 13s.; that which was manured with 1500 tons to the acre was worth £18. 14s.; with 3000 tons, £26. 18s.; and with 4600 tons, £31. 10s. I think, if the sewage were delivered on the land at £2 per 1000 tons, it would pay a farmer to use it. We did not employ any deodorizing substance at all. If there were a large accumulation of sewage, it might be necessary to do so. I do not think it would deteriorate the value of the sewage. The use of lime would not impair its value; for, though it causes a great precipitation, the ammonia still remains in the liquid.

Mr. ADDERLEY: You say that, if delivered at £2 per 1000 tons on the land, it would pay a farmer to use it. I presume it could not be delivered at ½d. a ton, and therefore it would not be commercially successful, even at Rugby?

Witness: I think it could.

Examination continued: It is a difficult thing to say what would be the average quantity of manure required. As the quantity of sewage applied is increased, the profit increases in the same proportion; but in dry manure, each addition over a certain amount does not tend to increase the product. We have gone up to 7000 tons per acre in the use of sewage, and there is no proof that we had then reached the limit of profitable application. I think there is no limitation. The sewage of the town of Rugby costs £600 a year. The tenants in the neighbourhood who rented it have now given it up, the quantity delivered being so small compared with the requirements of the land. They had a mistaken idea, and supposed that small quantities of sewage could be applied with great effect. They did not apply it in sufficient quantities, and were not satisfied with the result. Too much money has been spent upon the quantity at disposal. I should think the sewage of Edinburgh and Rugby would be about the same in quality. I do not consider that the manufacturing refuse of such a town as Birmingham

would affect the value of the sewage. The evidence given to the royal commission in 1858 with reference to Rugby was by Mr. Walker, an owner of land, and his tenants. Since then, I have made my experiments upon the same land. I should not like to say that my opinion is different to what it was when we reported; but I begin now to see something like what the actual value of the sewage is. It was thought before that there was some value in it. My experiments rather lead me to attribute a less value to it than before.

By Mr. BRISTOW: Six shillings is the value of the constituents in the sewage of each individual, but I should think the value delivered on the land would be from 1s. to 2s.; so that about £1000 a year is the value of the sewage of a town of 10,000 inhabitants.

By Mr. GREGSON: The land experimented upon at Rugby was good heavy soil. The rent per acre in its ordinary state was £5; I cannot say what it is worth now. Sewage does not permanently improve the value of land; it is worked out in about two years.

The CHAIRMAN: In the engineer's report upon the Edinburgh irrigation in 1851, I find that Mr. Lee states—"On inquiry, I was informed by Mr. Bryce, that the action of the sewage-water is not a sudden impetus, followed by reaction and exhaustion; but the land goes on increasiug in value, according to the length of time the system has been in operation." Do you agree with that?

Witness: No. I do not say that you might not, on blowing sands, such as at Edinburgh or Bagshot Heath, continue to improve it; but you will not do so with good soil.

The CHAIRMAN: Are you of opinion that a sandy soil takes up the ammonia?

Witness: Yes.

The CHAIRMAN: That is not in accordance with your own report, because you state that clay-lands and other lands consisting of loam and clay, are the only lands to apply sewage to; and the reason you gave is, that "the ammonia is retained therein, and the salts." Now, is the report right or wrong?

Witness: It is right, as far as it goes.

The CHAIRMAN: Then you go on to say that ammonia is liberated, and not retained in the sandy land; and, still further on in the report, you say that the salts imparted to it by the sewage, and the ammonia, when rain comes or water falls on it, are washed away?

Witness: You have a greater waste of material upon a sandy soil.

The CHAIRMAN: Therefore, it is not so appropriate.

Witness: I will not say that.

The CHAIRMAN: Supposing a ton of sewage is worth 2d. to the farmer when he gets it, is it not a matter of importance to him to retain all the value of it—the nitrogen, the phosphates, and magnesia—and that, therefore, if applied to a sandy soil, which will not retain these ingredients, they will be wasted?

Witness: As an abstract rule, it might be so.

The CHAIRMAN: In the report of your commission, in 1858, you state that the absorption of the offensive gases of sewage by the soil and by vegetation is so rapid, that there is no perceptible smell five minutes after the application; and it is, therefore, plain that, if closed drains or pipes were substituted for open ditches, the inhabitants of Edinburgh would cease to have cause to complain of the employment of the sewage. Do you still maintain that opinion?

Witness: Yes: I still retain that opinion.

Examination continued: I am now experimenting upon the water of sewage after it has percolated through the earth. I cannot give any results at present. We pay £5 a year per acre for the land at Rugby, and £4 per 1000 tons for the sewage delivered. I pay £150 a year for the branch and hydrant, which is capable of delivering 30,000 or 40,000 gallons a week, and I have a right to take all that is delivered. I have never used 9000 tons per acre. You might profitably apply 20,000 tons, but not at £4 per thousand.

The CHAIRMAN: If the sewage of a town is worth, according to your calculation, 6s. per head per annum, how do you account for it that it is only worth 2s. to you when you get it on the land?

Witness: By the enormous dilution, and the application of it at unseasonable times.

Examination continued: I should not like to say that sewage, as it flows over the earth, is not innocuous until absorbed. In the Essex marshes, I think it would be difficult to get it to flow; and I do not see how it could be applied to a very large extent of flat land.

Dr. *Hofmann*, examined by the CHAIRMAN.

I am professor of chemistry at the Chemical College, Oxford Street. Along with the late Mr. Witt, I received instructions from the referees on metropolitan drainage, in 1857, to make an analysis of the London sewage, and to test the value of certain plans for solidifying, and otherwise dealing with the manurial matters found therein. We commenced by ascertaining the quantity of solid matter contained in the sewage, such as is procured at the outfall of the sewers. The one which was pointed out to us as likely to give the most correct average result, was the sewer in Savoy Street. The sewage there was found to be extremely different in richness at different times of the day. It was found, for instance, that it was richest between nine and twelve o'clock in the morning; whilst, between twelve at night and five in the morning, it was extremely diluted. On this account, it was found expedient to select quantities of sewage at each hour of the day, and we obtained twenty-four samples, which were then mixed together. The solid matter obtained from these samples was subsequently submitted to chemical analysis. We then ascertained the quantities obtained in this sewage matter which belonged to the insoluble portion, and those which belonged to the soluble portion in the liquid, and we represented them in money values, comparing them with the price of guano at the time of the experiments. We made two consecutive experiments to ascertain the quantity of solid matter. The one related to the 13th of March, 1857. The total quantity of suspended and dissolved matter in one gallon of sewage was 94·7 grains. Of these 94 grains there were only 19 of suspended matter, and 75·7 of matter dissolved in the water. The second experiment was made on the 11th of June, 1857. The quantity of fixed matter which could be procured by the evaporation of one gallon of sewage was a little greater, being at that time 111 grains per gallon. Of these 111 grains, 32·7 were suspended matter, and the dissolved matter amounted to 78·5. Of the valuable matters of London sewage, six-sevenths are in a liquid condition, and one-seventh only in the solid state. The principal valuable constituents in sewage are: First, the nitrogen, which exists partly in the form of ammonia and partly in the form of organic matter; second, phosphoric acid; third, potass; and, fourth, organic matter. There are other constituents in the sewage, which, under particular circumstances, may be of some value, but which generally may be entirely disregarded. In a gallon of sewage, I found 6·7 grains of nitrogen, 1·8 grain of phosphoric acid, 1·0 grain of potass, and 30 grains of organic matter. In estimating the value of the constituents of sewage, it would be impossible to arrive at a correct calculation if the estimate were based upon the price which each individual substance could be bought for in the market separately. We, therefore, ascertained the price of an agricultural commodity in which these substances existed, such as guano, the price of which was then £11 per ton. Now, the solid constituents of 100 tons of sewage contain 7·982 tons of ammonia; and the ton of ammonia, such as it exists in guano, possessed, at that time, an agricultural value of £56. The amount of insoluble phosphate of lime was estimated at 1·269 ton; and the value, at £7 per ton, was £8. 17s. 8d. Of the soluble phosphate of lime there was 2·631 tons, the value of which was £84. 3s. 10d. Then, 1 ton of potass, estimated at £31; and, lastly, 30·1 tons of organic matter, estimated at £1 per ton, equal to £30. By taking the total of these items, we arrive at the value of 100 tons of the solid residue of sewage, which is £601. 3s. 6d., or £6. 0s. 3d. per ton. This number represents the value of a ton of dry sewage on the field, including the soluble and insoluble constituents. The suspended matter in one ton of solid residue is worth 15s. 3d., and the dissolved matters £5. 5s. —the whole being again £6. 0s. 3d. All the constituents I have given refer to the solid matter under evaporation. It will, perhaps, be more interesting to know the value of sewage without any evaporation, which is its ordinary condition. I have calculated that 100 tons of sewage contain of suspended matter 81·7 lbs., and of dissolved matter, 247 9—total, 328·16 lbs. Estimating 100 tons of the sewage on which we operated at 17s. 7d., the value is a little more than 2d. per ton. It was calculated, at the time of our experiments, that the average quantity of sewage running into the river Thames per day amounted to 95,000,000 gallons. Now, as 220 gallons weigh 1 ton, the 95,000,000 gallons weigh 431,850 tons. Calculating this quantity at 17s. 7d. per 100 tons, it shows that the daily value of the London sewage is £3796, and its annual value £1,385,540. I may say that we endeavoured to check this result by calculating, from accurate observation, the value of the sewage, such as derived from the fœces and urine of each individual, and, taking the population of London at that time at 2,600,000, we arrived at the yearly value of £1,444,177. We took guano as the standard of value in our calculations, the price of which, I believe, is now something higher. It has been constantly increasing in value, for we found, by inquiry, that ten years previously the price was one-half that which we took in our estimate.

By Mr. AYRTON: The experiments were made with the sewage from a dense district. I cannot say the area of rainfall which drained into it, nor how far the sewage was diluted with the land drainage, independent of mere house refuse, as the specimens were delivered to us by the referees. I have not made experiments to ascertain the effect upon the fertilizing property of sewage by allowing it to run for some distance in a river or stream. It may be that a portion of the solid sewage which was in a state of suspension would be deposited, but the soluble matter would not be affected in any way, except that it would be much more diluted. It would depend considerably upon the time of year and the temperature whether if sewage, unmixed with running water, were allowed to flow any distance exposed to the air, it would become decomposed. In the summer weather, some of the nitrogenous organic matter would undergo putrefaction. The ammonia in sewage is extended in such minute quantities as compared with the bulk, that it would not be affected. If sewage, such as we operated upon, were to run in an open culvert for 10 miles, exposed to the atmosphere, with a medium temperature, I do think it would, in a great measure, be in the same chemical condition as it was at the beginning—not perhaps in the very height of summer. The agricultural value would in no sense be diminished.

By Mr. ADDERLEY: The mean quantity of solid manure in sewage, according to our two experiments, was 102 grains per gallon. This gives 22,000 grains in one ton of liquid sewage. The question presented itself to us, whether the sewer we experimented upon was a fair specimen of the sewers of London, and we went into the matter. Very shortly before that time, similar experiments were made by a chemist, of the name of Horsman, upon the sewers whose outfalls are at London Bridge and St. Paul's. The total quantity of matter found by him was 129 grains per gallon, which shows, as compared with our results, considerable discrepancy. At St. Paul's sewer the quantity was 129 grains, and the lesser sewer examined in the same summer left, on evaporation, 106 grains. Again, I find the result obtained by professor Anderson, upon an examination of the Edinburgh sewer, was 132 grains per gallon. I should not omit to mention, that I find in my report an analysis by Professor Way, who examined the sewage delivered from a sewer in Dorset Square, and found as much as 209 grains of solid matter in the gallon. This is the highest result I have been able to ascertain. There was considerable variation in the weather at the time we made our two experiments upon the Savoy Street sewer. On one occasion there was a tremendous storm, and the next morning the sewage was charged with 296 grains of solid matter per gallon, although examination proved that the amount of water delivered by the sewer was at the least four times greater than was ordinarily the case. From this, we concluded that a large amount of deposit had existed in the sewer, which was flushed out by the heavy rainfall. The next experiments we made were at the Falconbrook sewer, where the proportion of solid matter per gallon was 44 grains; at the Earl Street sewer, where it was 48 grains; the Fleet, 67 grains; the Fleet, before rain, a succession of dry days preceding, gave 74 grains; then, the Fleet, after rain, 208 grains; the King's Scholar's Pond, 64 grains—before rain 91, after rain, 180; Northumberland Street sewer, 160 grains, at another time 144, and, in a third experiment, 147 grains.

Mr. ADDERLEY: Will your experiments enable you to tell approximately the mean fertilizing ingredients of each gallon of sewage—*i. e.* of ammonia, phosphoric acid, potass, &c.?

Witness: Forty grains are valuable matter.

By the CHAIRMAN: We did not collect the sewage for our experiments: it was collected by the referees, but I have had other opportunities of obtaining information respecting the nature of sewage at the outfall. Of course, it depends in a measure upon the season of the year; but, upon the whole, those who examine sewage at the outfall of a sewer for the first time, are surprised at its comparatively inoffensive character. It is only after some time, when it is kept in a cistern, that it becomes very offensive. Even in hot weather, I find that sewage as it flows out of the sewer, has but little that is offensive about it.

The CHAIRMAN: Bearing in mind that reply, I wish to ask you another question. Let us suppose the case of the sewage from the outfall of thr new sewers about to be made, pumped to a covered reservoir from the outfall through mains in the earth, and the reservoir ventilated by means of an air-shaft, in which every noxious gas from the sewage might be consumed with fire, and that the sewage descended from the reservoir, through mains laid in the earth at such a depth as to be beyond the reach of the atmosphere, that the mains were kept always full of sewage, and that from

these mains the sewage was delivered on the land through a jet by means of a flexible hose, might we not expect the sewage so delivered to be in a state as inoffensive as to smell as the sewage at the outfalls which you experimented upon?

Witness: The greater portion of the year, I should say, certainly. In very hot seasons, putrefaction might all at once set in, and then the offensive character of the sewage is great.

The CHAIRMAN: In the report of the commissioners, it is said that the absorption of the offensive gases of sewage by the soil and by vegetation is so rapid, that there is no perceptible smell five minutes after the application, and that if closed drains or pipes were substituted for open ditches, there would be no cause to complain of this employment of the sewage. Is that opinion correct?

Witness: I believe it is, but I have no practical experience of it. Of course, if you put it upon land that could not absorb it—as upon land already saturated with water, you could not expect it to be inoffensive. But, with land properly selected and treated, I think the sewage would be very rapidly absorbed.

Lord HOLMESDALE: You have heard the large quantity that has been spoken of—30,000 tons a year.

Witness: It would depend upon the nature of the soil. Some soils are extremely absorbing, and I dare say that quantity might be employed with good effect in some cases, where in others it would be impracticable.

By Mr. ADDERLEY: I should think there are no substances in the London sewage that would be injurious to vegetation, or that would neutralize the fertilizing properties of other ingredients, so far as our examination went. I do not think that the manufacture carried on in any town would influence the nature of the sewage generally. I can conceive of circumstances in which such a state of things might exist, but not in a place like London. I am not prepared to say off-hand, but I should be of opinion that the ingredients discharged from the chemical works of a town like Birmingham into the sewers would not deteriorate the value of the sewage.

By Mr. AYRTON: It would greatly depend upon the season of the year, as to how soon the fertilizing properties of sewage would be destroyed in water kept in a tank. Taking that season when the process of decomposition goes on most rapidly—the height of summer—you would, in the course of twenty-four hours, have a change in the composition of the sewage; and, in the course of eight or ten days, you would have accomplished the process of decomposition which is going on in the sewage alone. You would, in a measure, have affected the agricultural value, but it would be very minutely. If you exposed the sewage freely to the action of the atmosphere, it would have a tendency to destroy the constituents, but the agricultural value would not be deteriorated very materially. The deodorizing of sewage would, if some ingredients were used for the purpose, effect its fertilizing properties. Phenic acid is employed as a deodorizer, but not very extensively. I do not think it would have an injurious effect upon the fertilizing properties, if used only in sufficient quantity to deodorize the sewage.

The CHAIRMAN: I presume you know that the object of this committee is to inquire into the best means of utilizing the sewage of cities and towns, with a view to its application to agricultural purposes. With that view, what plan would you advise to be adopted for the purpose of raising the best revenue from sewage—to distribute it over large areas, where it would be used simply in addition to the manure of the farms, as guano is used at the present time, or that the use of it should be confined to small tracts of land?

Witness: This question presented itself, of course, at the time when we made our report; and we arrived at the conclusion that all proposals to use the sewage, except that one which proposed to use it for the purpose of irrigation, bore in themselves the proof of impracticability. In fact, we had not at that time the necessary data at our disposal for calculating whether the use of sewage for irrigating purposes would be profitable; but we came to the conclusion that, at that moment at all events, the proposition to employ it for irrigating purposes was by far the most promising.

The CHAIRMAN: Will you go further, and say whether, in your opinion, the sewage should be applied over a large area with other manures, and as an addition to them, or whether it should be applied to a circumscribed area, and no other manures used with it?

Witness: I must preface my reply by observing that I am not a farmer, and have no experience as such. I should say that, in most cases, containing the most manurial constituents of the plants which have been consumed by men and animals, it would be beneficial to most crops; but I would by no means express a decided opinion, that it is always applicable without the use of other manures. I conceive that the most useful form to employ it practicably would be to enable the farmer to use it either exclusively, or together with other manures, according to the nature of the crop he wants to rear.

The CHAIRMAN: Do you think that that system would ultimately produce a larger return for the sewage of towns than by confining its use to a small area?

Witness: *Cæteris paribus*, certainly.

MONDAY, MARCH 31.

Professor *Way*, examined by the CHAIRMAN.

I am consulting chemist to the Royal Agricultural College of England, and have had very frequent opportunities of making myself acquainted with the wants of the agriculturalists of this country as to the supply of manure. The resources of natural manures, as at present economized, are not sufficient for the cultivation of the soil, so as to obtain from it the full amount of vegetable growth of which it is capable. The deficiency has to be supplied by the purchase of foreign manures, and the manufacture of artificial manures at home. The great difference between modern agriculture and the system practised twenty years ago is, that we now bring into the land other manures than the land itself would supply. I think it would be very difficult to say what is the annual sum paid in Great Britain for foreign manures, but I could give you some opinion upon it. I believe the quantity of Peruvian guano, which is the principal foreign manure imported, is from 200,000 to 300,000 tons a year, and the cost from £2,500,000 to £3,000,000, taking it, in round numbers, at £10 per ton.

The CHAIRMAN read a letter written by Professor Liebig, ten years ago, in which the writer said that the result of the application of guano and bones to English agriculture ought to have taught the farmer in what a condition of comparative fertility he might have preserved his fields if the elements of guano, which he had annually transported in the shape of wheat produce, had been systematically gathered, and brought back again to the land. To the understanding of this question, however, the farmer had not yet come, for, while his forefathers believed the soil of their fields to be inexhaustible, he himself believed that the introduction of manures from abroad would have no end. It was much simpler, as he thought, to buy guano than to collect the sewage of towns; and that, if a lack of the former should ever arise, it would then be time enough to have resort to the latter. But, of all the erroneous opinions of the farmer, this was the most dangerous. He had been assured, with relation to guano, that in twenty or twenty-five years time, if the consumption was maintained even in the same proportion as then, there would not remain sufficient to freight twenty ships; and, when the price of bones became so high in Germany as to forbid their exportation, and the question came to be asked how this indispensable manure should be furnished for the future, it would excite astonishment that so little attention had heretofore been paid to the application of sewage to manurial purposes. He (the chairman) asked the witness whether he agreed in this opinion?

Witness: There is nothing but what one may easily agree with in the letter, but the whole question is a very large one—the reproduction of animal and vegetable life—which is not to be treated in that off-hand manner. The question of reproduction is involved in the question of the loss of manure by drainage into streams, but I think the argument, though perfectly good in the abstract—that we are wasting a large quantity of valuable material, by throwing it into the rivers in the shape of sewage—does not contain the whole truth, for there are other operations at work, which will always tend to diminish the fertility of land which is cultivated to give food to human beings. It is known as a fact that, where forests exist, the richness of the soil increases rather than diminishes, because the mass of the food of vegetation is obtained from the atmosphere rather than from the earth, and whatever is obtained from the latter is returned to it in the fall of the leaves from the trees. In the case of the growth of vegetation for the use of man or beast, we have a different state of things, because a great deal more of the material of the soil is used in producing a quantity of barley, oats, or wheat, than we actually fix and have back in the shape of corn. It is found that wheat, and all those plants which produce albuminous matters fit for the support of man, actually waste the elements of vegetable matter; they get rid of ammonia in the act of growing, and, therefore, the ground upon which they are cultivated would become impoverished; and, apart from the question of returning the *débris* of the food of man to the soil, we should never keep up a good state of cultivation by the use of sewage alone, upon the same amount of land which produced it. As to the use of guano, it must always be remembered that we may have a balance of advantage in a pecuniary point of view, in the restitution to the land of manure, in one shape rather than another. The argument may be open to objection, that it would be more economical to replace these matters by an imported material rather than by putting the sewage upon the land again. I do not think the fact that we are now wasting sewage is a proof that it ought to be put on the land.

The CHAIRMAN: Do you agree with Baron Liebig, in thinking the supply of guano and bones is limited?

Witness: Guano may be, and I fancy must be so. Probably fifty years or more may see it worked out. I do not think it is so with bones, because the more agriculture the more stock you produce, and the more stock the more bones. There is really a vast quantity of phosphates in most soils, which it will take us some hundreds of years to work out. The price of guano, I think, is diminishing; it was £20 a ton at first; afterwards, it went down to £9, in consequence of the introduction of the supply from Ichaboe. When that was exhausted, the price went up to £12. There is no supply from Ichaboe now. At this moment, artificial manures can be profitably applied at present prices.

The CHAIRMAN: Liebig says that "10 million cwts. were impotred in 1855, and in the course of half a century 60 million cwts. of bones have been imported into this country, yet all this mass of manure is not worth mentioning, when considered in relation to the arid surface of Great Britain. It is but as a drop to the sea of human excrement carried to the ocean, which can only be partially supplied by artificial manures." Do you agree with him?

Witness: I agree so far as this, that if he had limited himself to stating in what years these have been imported, you would find that two-thirds of the whole have been imported during the last 10 years; consequently, the first 40 years of the half century ought to be left out of the calculation. Bones were only used twenty years ago to make animal charcoal for sugar refining. The quantity, therefore, is much larger, when spread over the ten years; still I believe it is small as compared with the quantity which could be consumed on the lands under culture.

The CHAIRMAN: From the works of yours which I have read, I believe you are deeply impressed with the necessity of converting sewage to agricultural purposes?

Witness: I think it is a great pity it should be wasted.

The CHAIRMAN: You were one of the royal commissioners appointed to consider the best mode of distributing the sewage of towns, and applying it to beneficial and profitable uses. In your report of 1858, I find the outline of a plan for dealing with the sewage of the metropolis, in which it is proposed that the solid matters shall be separated and precipitated. Is your commission still of opinion that precipitation is the plan that should be adopted in dealing with the London sewage?

Witness: I do not think it was ever of that opinion. I think at the time that paper was written, it was assumed by the commission to be perfectly impossible that the London public would vote £5,000,000 or £10,000,000 to deal with the sewage upon a large scale. The whole of our preliminary report, if read carefully, indicates that the liquid system is the only system which could be properly applied.

The CHAIRMAN: The report says, "The solid matters would be separated and precipitated, and the liquid treated with some deodorizing agent before discharge."

Witness: This report was made before the Metropolitan Board obtained their Act, and had decided to carry the sewage down the river. We, therefore, had to deal with the sewage in its existing state. My conviction is—and I have no doubt it is that of my colleagues—that we proposed a plan most likely to be available with the means and disposition of the London public: not that it was a scheme we preferred, but as being the only one possible. We were of opinion that, in a sanitary point of view, it was most objectionable to discharge sewage into rivers.

The CHAIRMAN: I find, in the latter part of the 4th suggestion made in your report of 1858, you state, "that the direct application of sewage to land favourably situated, if judiciously carried out, and confined to a suitable area, exclusively grass, is profitable to persons so employing it; that, where the conditions are unfavourable, a small payment on the part of the local authorities will restore the balance." Be kind enough to state what you meant by favourable and unfavourable conditions?

Witness: I take it to be this, that a town may be so situated with regard to neighbouring land—in fact, that there may be no neighbouring land to which sewage could be applied without considerable expense, and that then the system of liquid application might be so far less than profitable, that it would require an outlay, on the part of the town population, to carry it to

land which may be more favourably situated, and where it may be profitable. There are towns, for instance, which are situated near the sea, where the only low-lying ground may be the sea-beach, to which it could not be applied. In that case, it would have to be distributed on land on the level of the hills; that would be an unfavourable circumstance. On the other hand, there are many cases in which grass-land, or land suitable for sewage, is immediately adjacent to the town, and there it can be profitably employed.

The CHAIRMAN: Why did your committee consider it exclusively applicable to grass-land?

Witness: Before writing this report, we had seen all the instances of sewage irrigation which at that time existed in England and Scotland. We had also been to Milan; and this report furnishes an account of what we saw there. Our conviction was that, although sewage benefited all crops as much as any other manure would, the first cost of arrangements for distributing it to other crops except grass, or what was analogous to it, together with the subsequent yearly expense of distribution and the small quantity which could be got rid of in that way, were objections to its general use; and that the most convenient crop—the crop which lent itself most readily to the application of sewage—was some form of grass.

The CHAIRMAN: I refer to your report, on page 15, where I find you say, in reference to Edinburgh: "The crops—almost entirely grass—are of the richest description, as may be judged from the fact that they are sold by auction every year, at an average of from £20 to £30 per imperial acre."

Witness: I think that sentence really means that the land was let at that rental, and not that that was the value of the crop; but I am not quite sure.

The CHAIRMAN: I think I can, perhaps, help you with the next question. In the following paragraph, you say: "The works were undertaken, in the first instance, solely with the view of profit; and they have answered so well, that the meadows, some portions of which were formerly barren seasand, are now a very valuable property."

Witness: Yes, it is so. I think it must mean the crop; it is an average. Some land is so much more valuable than other.

The CHAIRMAN: Who are the parties benefited by these works? Are they the proprietors of the meadows, or the ratepayers of Edinburgh? or are both parties benefited?

Witness: I should imagine the ratepayers get nothing by it.

Examination continued: I should think the profits from the meadows do not in any way go to the assistance of the local taxation. I consider that the sewage of Edinburgh is, at least, as valuable as that of London. I am aware that as much as 8400 tons of sewage per acre is annually put upon those meadows. Assuming the actual manure contained in such sewage is worth 2d. per ton dried, that would produce £70. 12s. I should think that £70 worth of manure would produce better results than that—it is a calculation very easily made. The answer to that question would possibly be a check upon the value of sewage at 2d. per ton. The only way is, to take the composition of sewage and calculate it out; to take the quantity of guano, and see how many hundreds of tons of sewage is equal to that value of manure. I have, perhaps, taken it the reverse way. It may be convenient to assume the value at 2d. per ton, but I think that is very much more than the value of sewage. I have made experiments with other manures in a liquid state—for instance, superphosphate of lime is put on in a liquid state; and Mr. Mechi's farm is an illustration of other manures being put on in that way.

The CHAIRMAN: In such an application of guano or other manure, would you expect to recover from the soil the value of the manure which you had applied in addition to the expenses of management?

Witness: I think not. If you were to offer me £70 worth of guano in a liquid state, I should not give you £12 a ton for it, because I should have to deal with the quantity of water, which would only be an incumbrance. For instance, if a man brought me some Peruvian guano mixed with its same weight of sand, and offered it at £6 per ton—the ordinary price of guano being £12 per ton—I should not buy it, though its intrinsic value would be the same, because all the expenses would be doubled; the cost of cartage, &c.

The CHAIRMAN: Is not sewage a thing to be bought and sold, if you can find a market for it?

Witness: Yes, and wherever that market can be found, the price would be regulated like that of guano, by the demand; but, in the first place, you have to decide upon what ground that demand is to take its stand; you cannot at all predict what that demand would be. There are two ways in which you might have the sewage. You might take the manurial substances, which a 100 or a 1000 tons contained, and say, according to the market value of other manures, they are worth so much; but, unless you have a number of experiments and practical employment of manures distributed through a quantity of water by which you can note down the relative effects, you have yet to learn whether a ton of guano would produce the same result when diluted with that quantity of water or not. Until that is learned, you cannot say what the price of any given demand may be. It might so happen that the annual cost of putting on sewage might render it more expensive for use, even if the pipes were laid on the land, than the employment of a similar amount of dry manure, bought in the shape of guano, and in that case you would reject it altogether. Many steps have been taken to ascertain the value of sewage during the last few years, but I still think the actual value is not so clearly determined as in other cases of manure. We have learned to value ammonia or phosphate of lime in artifical manures, and know that so much put on the land, under such circumstances, will produce a given result. A farmer, if he is growing turnips, or mangel-wurzel, will know that if he puts on 2 cwts. of phosphate of lime, he gets so much greater increase in his crop. But here you introduce a new element, which throws all previous calculations aside.

The CHAIRMAN: I find in your report, you say that "In times of heavy rain, the quantity of sewage liquid which comes down at Craigentinny is so great, that it is found impossible to deal with it otherwise than by allowing some portion of it to escape into the sea; but, with this exception, and that of the open ditches, it may be safely asserted that the method pursued at Edinburgh, deals with sewage as a thing to be got rid of with great success." I presume, then, your committee had more in view in the question of getting rid, at any price, of the sewage than that of regarding it as an article of commerce.

Witness: I think I am justified in calling attention again to the fact that this report was written five years ago; and, at that time, nobody was so far advanced in the knowledge of the value of sewage as at present. Our commission bound us to inquire into the best mode of distributing the sewage of towns, and applying it to beneficial and profitable purposes. Now, that phraseology was certainly adopted not without some distinct intention, there being two objects contemplated by that commission, the one a sanitary object to get rid of the sewage; the other, if possible, to apply it to some beneficial purpose. If we could not apply it to some profitable use, we were still not exonerated from finding out a method of getting rid of it; therefore, you will see that, throughout, we endeavoured to answer these two objects; so that it does not at all affect the question, or prove that we were not alive to the value of sewage; on the contrary, we knew its value, and our first duty was to find some means of separating it from towns. Then, there is another question—namely, that the commission was not at all confined to London, or other large towns. We had to deal with many places which, for several years, would not be likely to adopt any system of liquid sewage.

The CHAIRMAN: Did you consider that the fact of allowing it to escape into the sea was a beneficial and profitable use of it?

Witness: This is an exception placed here, distinctly so, showing that we did not so consider it. I think all the plans for the utilization of town-sewage have had in view the escape of the storm waters.

The CHAIRMAN: In page 18, the commission state that the distribution of sewage over too large an area of land is an error, both as limiting the quantity of fertilizing matter applied, and the benefit which the land receives in time of drought. In reference to this, I wish to know whether, in speaking of the area, you calculate that it should be manured exclusively with sewage, or with sewage in addition to other manure?

Witness: Our impression throughout—and it is not the impression of a day, but one arising from a constant attention to the subject, and from all the information we could gain—has been, that the best form of applying sewage, to be economical and profitable, and to give the greatest return, is to apply it in large quantities to grass-land; and that the theoretical waste of sewage in that way is really less than when applying it in small quantities. As sewage contains all that is wanted on the land, if the water with which it is diluted is not an objection, it may be applied exclusively. In our report, we state—"The second error to which we have alluded is the application of sewage to crops, for which it is not well suited; thus, in addition to natural and artificial grasses, it has been, and is, applied to turnips, and green crops generally, and to wheat, and other corn crops. It is not at all intended to assert that liquid manure does no good to those crops. On the contrary, it is at once admitted that it may be applied to them with great advantage, and, in many cases, it is an immense benefit to the farmer to have the opportunity of so applying manure, especially in the case of turnips and mangel-wurzel. But it must be borne in mind that the problem to solve with regard to town-sewage is not a simple one; it is one of considerable difficulty—viz., how to dispose, day by day, of a large quantity of liquid which will not admit of accumulation?" It is not at all the engineering difficulty which is there alluded to. So far as these crops are concerned, we say that the growth of corn, and even of green crops, does not allow of a daily regular application of the liquid; and, however beneficially it might be applied to them at times, for a large number of days in the year its use is inadmissible. There are three months when you want to keep the wheat crop as free from moisture as possible, and you could not apply sewage with any beneficial effect at that time.

The CHAIRMAN: I find in the same report, you say—"Moreover, as the cost of laying down pipes entails a large annual expense in reduction of profits, and as this annual expense is directly as the amount of land treated, it follows that the application of sewage to those crops which cannot regularly receive it, is a mistake." With reference to that statement, I want to refer you to a report of the General Board of Health in 1852, from which it appears, without going into details, that the annual charge on land, calculating the interest on the capital sunk in distributing pipes, hydrants, and other apparatus, at 7½ per cent., does not exceed 2s. 7¾d. per acre.

Witness: I presume that is Mr. Austin's report.

Mr. AYRTON: It is the result in certain specific cases. I think it is on an assumption that the land is flat land, and that a certain length of pipe of a certain size, over a certain sectional area, with so many hydrants at so many places, &c. costs so much.

Witness: It does not include all repairs. This seems to be the first cost per acre, and the annual charge upon the original outlay.

The CHAIRMAN: Taking that for granted, together with the result obtained by the chairman of the royal commission, by his experiment with sewage, in which he obtained a clear gain of over £2 per acre upon his wheat, and a great increase in his green crops, are you still of opinion that it would not pay commercially to lay down pipes to treat such crops with sewage?

Witness: My evidence you will take with all the deductions I am to make here. We have been so long with engineers, and so many years engaged in seeing these things in operation, and in discussing them, that one comes to have a compound opinion which has been formed by degrees, and which it is not possible in a moment to give all the reasons for. But, certainly I have not seen anything to change my view in all the examinations I have made, and all the papers I have heard read, that it is more economical to apply sewage in large quantities to crops that are suitable, and that in that way you would get the largest return.

Examination continued: It is merely the form in which sewage is presented, as mixed with so much water, that makes it unsuitable for some crops, and not that there is anything unsuitable in the sewage itself. I have made experiments upon the power of soils to absorb manure. The results generally were these—that in soils there resides a power which, previous to my examination I believe was not recognized, to separate from the liquids contained in the manure, the ammonia, potash, phosphoric acid, and magnesia—all the important elements in fact; so that if we were passing a liquid containing manurial matters in a given quantity of ground, the water would pass through, and these matters would be retained and fixed in the soil. I look upon this as a great arrangement and provision of nature for the preservation of the manurial principles from being washed out of the earth by rain. I have found that sewage-water after it has percolated through the earth is pure if it has not been put on in too great excess, because, of course, at a certain point, the power of the soil ceases; but you may put a considerable quantity, and the liquid will run through bright and pure, and deprived of offensive matters. The minute the liquid has vanished from the surface, there is no smell. If you put it on a fallow field, you will not smell it three minutes afterwards; if you put it upon grass, a certain quantity will remain upon it. So long as it does not come in contact with the soil, it is not deodorized; but if it sinks through rapidly it will be deodorized as it passes. Indeed, so strong was my conviction on this point that I proposed a long while ago that water should be purified by running it on land properly arranged with under-drainage, for the supply of towns, because I believe that, with the exception of wells, there are many land waters which would be much better for domestic use if filtered through soil. You will find in many counties that the land drainage is used by the cottagers, and is very pure.

The CHAIRMAN: In a paper of yours published in the *Agricultural Journal*, I find an analysis of the London sewage, and that you say it is worth 3s. 6d., or within 2-10ths of 4d. per ton. Is that the actual money value?

Witness: This is the money value given to two samples of sewage. I think you will find in that paper, or in one also published in the same journal, I express my most certain conviction that no distinct argument could be formed on this data. It so happens that there were two samples taken from two places in the interior of the sewers of London, both infinitely more highly charged with the elements of manure than any specimens which I, or any other chemist had examined. For instance, here are nearly thirty-six grains of ammonia per gallon in one test, and I have made dozens of analyses in which the ammonia has not exceeded seven or eight grains. The last sentence of my paper states that the calculations given must be looked upon simply as the expression of the great agricultural value of sewage, and not as an attempt to fix that value at any approximation to the truth. I should say that all my subsequent experiments prove that these calculations were very exaggerated. It so happens that, in an examination of the sewers of London, there is little hope of getting at a clear indication of the value of the sewage. The sewers have been properly said to be merely extended cesspools, in which the sewage runs very slowly, and precipitates some of its heavy solid matters as it passes off. At one place, more is precipitated than at another; and, in times of flood, the whole mass is moved again, and goes somewhere else. The consequence is, you can never get two samples which are of the same value.

The CHAIRMAN: I wish to direct your attention to a paper written by Professor Voelcker on sewage manure. He says: "Sewage is truly a well-known yet unknown mine of gold, equal in value to half the interest of the national debt." You must be aware that Professor Hofmann said, the other day, that the London sewage was worth a million and a half of money, so that this is not at all an exaggerated statement. "We might call it a stream of liquid guano. We may estimate its value by the sums expended annually to compensate for its loss. We pay for our guano £2,000,000 annually, and large sums in unprofitable oil-cake, &c., to keep our manure-producing animals; and vast sums are also annually expended in phosphates and other artificial manures. Nationally, the neglect of sewage is a very great calamity, but one which it is to be hoped may receive a gradual and wholesome correction. It is not more difficult to convey than water which intersects our streets, and finds its way into every house. It is a question for landlord and tenant, for our legislators, and for the country at large. The recent experiments of Mr. Way have shown that we may apply our sewage to our clay soils at any period, and in any quantity, and that the valuable manurial solutions will remain in the soil, chemically arrested by the power it possesses, for the use of plants, and for the ultimate food of man." Do you agree in that opinion?

Witness: I believe that the value of the matters in the sewage is very great, but, I believe, it is their liquid condition which diminishes their value enormously. It is not fair to say that because the manurial value of the ingredients in sewage is so much, that the sewage itself is, therefore, worth so much.

The room was here ordered to be cleared. In about ten minutes, the doors were reopened, and the examination of Professor Way continued.

Witness: I consider it would be a great advantage, if a system could be devised, by which our cities and towns could derive a revenue from the sale of their sewage. If they could get better terms than by giving it away they should do it, but that involves the whole question of what the value of sewage is. Though we can compute the value of the constituents, we can only form an approximate opinion as to the value of sewage as such.

By Mr. PAGET: There are circumstances in which the use of other manures with sewage might be extremely desirable. The phosphates in sewage are not in such abundance as would be required for some plants, and, if used for turnips, I should think it would be well to mix some other manure with it.

Mr. PAGET: Mr. Lawes told us that the benefit to be derived from sewage was in the ratio of its application.

Witness: I confess that is one of the things I cannot see to the bottom of. If you put on more of the constituents than the plants can take up, I do not see how, by doubling that quantity, you can double the crops. It shows that some plants benefit by the very large doses of water they get at the same time. There is one circumstance which is often forgotten in reference to the application of sewage. If you produce 1 lb. of ammonia, or nitrogen, which is about the quantity in a bushel of wheat, you must use in your manure five or six times that quantity. It does not go into the plant, nor into the soil; it is lost. I say that, from calculations I have made, if we put 1000 tons of sewage, such as I find at Rugby and other towns, upon an acre of land, we should not take out more than one-tenth of that in the crop.

By Mr. BLENCOWE: I do not think that dry manure, in the nature of guano, can be obtained from sewage. The separation of the solid matters may be adopted for the sake of getting rid of the nuisance of the sewage to a town; but I do not think that the preparation of dry manure from sewage would be attended with profitable results.

By Mr. GREGSON: I should think the real value of sewage is more nearly ½d. per ton than 3d. The quantity of sewage for each thousand of population would depend upon the water supply of the town. I estimate it at 35 or 40 gallons per head per day. I believe you can produce £30 or £40 additional value per acre of land, by the application of a very large quantity of sewage.

By Mr. AYRTON: The commission of which I am a member presented a report in 1858, and another report is in type, which will be ready in a few weeks, and would have been presented sooner, but for the deaths of Mr. Austin and Dr. Southwood Smith. The basis of those reports has been more the result of observations of what other people are doing than by any experiments made by ourselves. There have been two classes of experiments made—one intrusted to me, to ascertain the result of the different processes for the precipitation of sewage; and the other conducted by Mr. Lawes, under our superintendence, at Rugby. The result of the former shows that you may largely reduce the evils of sewage, in a sanitary point of view, by precipitation; but, for manurial purposes, it is of no service at all, as the manure costs more than it is worth. I hold that, in the abstract, sewage is good for any crops, at any time; but there are cases in which, if you were compelled to take all the liquid which falls for agricultural purposes, you would undo all the good which the sewage, as such, would afford. I do not think the fertilizing properties of sewage are diminished by being allowed to run in open drains, unless the sewage is exceedingly strong. The oxygen in the water does not have any effect in destroying its value for agricultural purposes. The organic matters in the sewage in oxidizing give rise to ammonia, which remains in the liquid. Running streams purify themselves in the course of a few miles, because the body of water is so large in proportion to the impurity which finds its way into them; but, in the case of sewage, there is a large quantity of carbonic acid, which prevents the ordinary oxidation which occurs in a river. The soil I prefer, if I were applying 10,000 or 20,000 tons of sewage per acre, would be that which is not too heavy nor too light. A perfectly sandy soil possesses comparatively little of those properties which I pointed out in my paper; while, with heavy clay, it is difficult to get the sewage thoroughly incorporated with the soil. The best quality is good loam. I can hardly form an opinion whether, apart from sanitary considerations, the best thing, in an agricultural point of view, would be to have cesspools for the retention of the sewage. It appears to me that no population would ever go back to the use of cesspools, so that I have hardly given a thought to the pecuniary advantage. In Paris, in many cases, there are large cesspools in the basements of the houses, which are sealed under police regulations, and are pumped out into night-carts. Every one who has passed through Paris at night knows how disagreeable that is, and that there is no house in Paris without a smell. I believe, in places where the population is small, any attempt at sewage irrigation is a mistake.

By Mr. ADDERLEY: It is hard to say which is the best system at present pursued. In Scotland, the best results are shown at Edinburgh, and in England at Rugby. I think there would be no difficulty in finding sufficient land to distribute the whole of the London sewage upon. After the precipitation of sewage, I believe that 9/10ths of the value remains in the liquid. Its chief value is on account of the ammonia, and that is always retained in the liquid. The solid matter contains nitrogen, which is the same thing, but the quantity is so small that it is not worth the carriage of the bulk. The action of lime in precipitation has no influence upon the organic matter, which is nitrogen. I do not think that, practically, the manufacturing refuse of a town would make any difference in the value of the sewage, as it is very small in comparison to the fœces and urine. In Manchester, they still use cesspools, and there is no attempt to alter the old system. The proprietors of houses there are also the law-givers; and the expense of putting in sewers is so great, that they are much opposed to it. I cannot tell whether in Manchester a considerable profit is made by the sale of the contents of the cesspools; the proprietors of houses save a great loss in the saving of water supply.

By Lord HOLMESDALE: No doubt, if the urine and fœces could be evaporated, it would be a most valuable manure. None of the French plans would be available here.

Dr. *Frankland*, examined by the CHAIRMAN.

I was engaged with Dr. Hofmann, instructed by the Metropolitan Board of Works to inquire into the question of the deodorization of the London sewage. The process which we finally recommended for adoption was one depending upon the application of perchloride of iron, which, after trying a large number of materials, was the only one which appeared to fulfil all the necessary conditions. There is not, perhaps, sufficient data to give a very decided answer to the question, but my own opinion is, that the perchloride of iron would not deteriorate the manurial value of the sewage. I have estimated the value of sewage as manure. I think that taking the materials present in it as manurial agents, they are worth something like 2d. per ton. But it must be understood that experiments are yet wanting to prove that this value of 2d. will really be received from that amount of sewage by the land to which it is applied. It is still an open question. I think certain parts of those valuable constituents might pass away with the drainage water, and other constituents might in a dry season evaporate, so that the value might be much reduced. I have had a number of plans before me for dealing with sewage. My opinion at the time was, that the only available method for treating it as a manurial agent, was to use it in the way of irrigating the land, either with or without deodorization, but, if possible, certainly without deodorization. I have some little experience as regards its offensiveness or inoffensiveness during such application, and also as regards sewage flowing in very hot weather from the mouth of a sewer. In the application of very concentrated sewage to land, the odour is almost immediately absorbed, and I have found that the liquid flowing from the London sewers, in very hot weather, is not at all offensive. It is only when it is stagnant that it is offensive.

Mr. PAGET: The use of carbolic acid has been referred to: and it was stated that the effect was to coagulate the albumen. Would that affect the quality of the sewage?

Witness: Certainly not. If the coagulated albumen is finally conveyed into the soil, the only loss would be that arising from sediment, as it would be liable to precipitate. If the manure were agitated previous to its application, it would be pretty equally distributed. It would be less immediately available to the crops if coagulated, and more likely to lie for a certain time fermenting in the soil, but eventually it would be of benefit. I think that deodorization is not at all necessary in ordinary seasons, and only in very hot weather.

By Mr. ADDERLEY: I think it would be of very rare occurrence that the particular manufactures carried on in a town would affect the value of sewage for the purpose of manure. I cannot, at the present moment, call to mind any manufacture carried on, on such a large scale as to be able to deteriorate the sewage. I think the burning up of grass by the application of sewage has arisen from its freshness when applied; if it had been allowed to stand some time, or been conveyed through a length of conduit, such a thing would not have been liable to occur. The undecomposed matters, the sulphuric acid, &c., in cows urine, would have a special tendency to burn up grass. If precipitated, I think the solid deposit of sewage would not pay for its carriage. The whole virtue of sewage is in the liquid portion of it.

By the CHAIRMAN: I think it very desirable that sewage should be made useful. The present mode of disposing of it is a great waste of a valuable material.

THURSDAY, APRIL 3.

At the Meeting of the Committee this day, Sir Baldwin Leighton, and Mr. Caird, took their seats as members.

Alderman *Mechi*, examined by the CHAIRMAN.

I have been for the last eighteen years engaged in a system of agriculture, and, for the last ten years, I have applied the bulk of the solid and liquid manure upon my farm through pipes, by means of a hose and jet, driven by steam-power. The crops to which I have applied liquid manure are the ordinary farm crops—the cereals, leguminous, and pulse; also, to the natural pasture and Italian rye-grass. The liquid manure is mixed up with the sewage from my house, resulting from 12 persons. In some cases, I have applied it directly to corn crops, but generally indirectly. If the corn crops were taken on the land that was not rich enough to produce a large crop, I there applied, in the first instance, a dressing of sewage, which resulted in an improved crop. But, as a general rule, the corn crops are taken after clover, or roots, or other green crops. It is considered safer farming to manure these crops than to apply the manure to the wheat, because the latter may be made too luxuriant and fall early, thus diminishing the result. But, if my land were recently taken, and poor, I should

desire no better or more immediately active manure than the sewage of a town. I have found it, when applied to the land, have a very considerable effect, in illustration of which I may state that there is a field of five acres immediately opposite my drawing-room window. The land has ever been considered very poor, miserable, yellow, plastic clay. After drainage, I still could not succeed in raising a good crop of grass on that field, although sown with the very best grass seed. The indigenous, bad seeds choked the good grasses, and I had no result. But, when I irrigated with sewage those five acres, the effect was almost immediate. Certainly, within six months, a better class of grasses were produced, and, ever since, I have had heavy crops of grass and hay; making the animals fed upon it—the cows particularly—in a far improved condition, and giving an infinitely better quality of milk for cream and butter. This is so obvious this very day, that on my lawn, which has not been irrigated, the grass is of a bad colour, and miserable-looking; while, on the pasture adjoining, it is rich, luxuriant, and of an intense green, and it has shown that effect for the last eight or nine weeks. The result of feeding cows upon grass-land, treated with sewage, is unmistakeable. Not only is the condition of the cow greatly improved, but, concurrently with that, the quality of the milk and its power to give cream and butter, are very largely increased Its quantity also is increased, but its quality enormously so. The butter we used to produce appeared very slightly greasy; it would roll and crumble, having no quality, but, since the field has been irrigated with sewage, it has been very much improved. The difference in the value of that land I should estimate at not less than £3 per acre. I have had experience with regard to the folding of sheep upon land, and the effect produced thereby. I invariably fold my second crop of clover; I also fold off a portion of my tares and some other crops. I believe it is acknowledged amongst good farmers, that 1000 sheep well fed—I mean with cake in addition to the produce of the land—and folded for twenty-four hours upon one acre of ground, would produce a manuring sufficient for two or three ensuing crops. I must express my conviction, that the land of England, generally, does not have above half of that quantity folded upon it per acre, as an average. I consider that 1000 individuals in a town might be fairly and advantageously balanced against 1000 sheep and lambs on the farm, as regards the question of manure. Weight for weight, they would probably be superior, and, from the character of the food they consume, we may safely infer that their manurial results would be more valuable than those of sheep.

The CHAIRMAN: Have you any data to go by as to the number of days in a year during which liquid sewage can be applied to land?

Witness: With the exception of hard frosts, sewage may be always applied. We apply our sewage, as we think, with most advantage on wet days—we have been irrigating during the past few days. The great difficulty—the great objection generally raised against town-sewage is, that the large rainfall mixed with it impoverishes it very much. Now, Mr. Bazalgette, in a paper read before the Society of Civil Engineers on January 31, 1857, says that in 1855 there were 227 dry days, 90 days in which the average amount of rainfall varied from the smallest fraction to the 10th of an inch, 21 days in which it was from 1-10th to 1-5th of an inch, and 28 days in which there were heavy rainfalls. Now, with the exception of the 28 days of heavy rainfall—and even the first and second of those days might be very useful—I see no reason why the sewage of London should not have been continually available and beneficial to the land. With regard to sewage, I would venture to express my opinion, from observation, that for grass-lands the water itself has a very considerable value. In the growing months, a rainfall of an inch in 24 hours, which would probably be 100 tons per acre, would, at the critical periods of growth, increase the crop very largely, quite irrespective of its manurial value, as I think every farmer will admit.

Examination continued: I use on my farm the products of a spring of water, running a considerable quantity daily. The temperature of that spring is at 46°, as most springs are. In the early spring, when I use that water for the dilution of the sewage, I find that it stimulates the growth by its peculiar warmth, in comparison with the temperature of the atmosphere and the soil. I cannot say, distinctly, what the temperature of our tank-manure is, but I know that practically, by fermentation, it becomes warmer than the ordinary water, in the spring months. In the summer, we know that the surface of the soil attains a temperature many degrees beyond that of the atmosphere. I think that, in the hottest day, a fallow attains a temperature of 130°, the atmosphere being then only 70° or 75°. Now, when water or sewage is thrown upon that soil, it robs the surface of its temperature, and passes down to the low subsoil, which is naturally at a temperature of 46°, and the effect of the warmth on that substratum, is, as we know, to produce a more rapid growth of plants. We have an illustration of that on a rainy and warm day. No doubt, in cold weather, sewage imparts a certain amount of heat to the earth, and, for this reason, I now see on my farm Italian rye-grass fit to cut, while the neighbouring pastures are bare, and where there has been no growth. In March, or the early part of April, large quantities of grass are cut on my farm, while the neighbouring land shows little vitality. In my opinion, the application of sewage to corn and green crops would be generally beneficial, because the sewage of a town contains all the elements of every crop that is grown—it must be so from the nature of the articles consumed.

By Mr. PAGET: I cannot give exactly the proportion of sewage contained in a gallon of the liquid manure which I employ. There is an immense body of water always mixed with it. We allow a stream of 40 gallons a minute to keep running into the tank during the whole time we are pumping; as we put on 100 gallons a minute with our jet, unless we were to do so, we should soon exhaust our supply, and our object is to get on our grasses the largest possible amount of moisture. In fact, we frequently irrigate, when there is very little virtue in the sewage, for the purpose of stimulating the growth of the grass. If you ask my opinion whether I should desire strong manure to weak, I say, in wet weather I should put it on very strong, but I should be afraid to do so when the weather is hot. I have seen mischief done, and have done it myself, by putting the manure too strong on a crop of clover during dry, warm weather. We put on about 60,000 gallons of liquid per day, but not during the whole year, as we have not enough manure for the purpose. If I had more sewage, I should have more grass-land, and could employ it. But I am limited by the quantity of manure. I cannot give the proportionate amount of solid to liquid in our sewage.

By Mr. BLENCOWE: I produce a map, in which you may see the precise lines of my sewage-pipes. I have 170 acres of land under sewage. I have only 5 acres of permanent grass, and generally about 8 acres of Italian rye-grass, on which I place much sewage. I apply it to corn crops originally in the spring, just before the branching, and some a little later. I consider that it costs me something under 1d. per ton—*i.e.*, 210 gallons—to place the sewage on every part of my farm. There were no buildings on the land when I first went to Tiptree; I erected them all, but not in reference to this system. It was not thought of until ten years after I went there, and not until I had got my engines for other purposes. I think it right to state that, but for the large quantity of water discharged by my spring, I should not attempt to carry out the system of irrigation. When I have administered the dose very strong, the water has come through the land highly coloured, and smelling, even at a depth of five feet of strong clay. The same thing will take place with a dung-heap, even if placed on strong soil. I know a case in which a dung-heap was placed upon a very stiff headland of clay, and, on a heavy rain occurring, the manure came through, smelling very strong, and highly coloured. But, I am assured by chemists who understand the matter that, though coloured and smelling, the bulk of the valuable ingredients of the manure have still been retained by the soil. Because of its coming through in that way, I think it exceedingly injurious to put highly concentrated manure in large quantities on the land, and that the dilution of the London sewage will prevent it ever becoming a great public nuisance. I believe the soil abstracts most of the valuable products from the manure, and that the colour and smell are not indications of the most valuable portions passing off.

By Mr. CAIRD: The 1d. per ton is the cost of applying the sewage, without any reference to the value of the sewage itself. If I were told by eminent men that 6000 tons of sewage per acre were necessary to produce a good effect upon the ground, I should think, under certain circumstances, it would be remunerative to put it on the land, even if the cost of applying it were 1d. per ton; and I will tell you why. The more sewage I apply upon growing grass, the more I grow; and we have evidence of this fact in the Edinburgh meadows; but I think it would be a public nuisance to put on that large quantity. I base my opinion of the value of town-sewage upon practical observations of my own. I have said before, that I consider a human being to be in manurial value equal to a sheep. The manurial power of English agriculture is only two sheep per acre annually, reckoning bullocks equal to a certain number of sheep. The natural conclusion is, that if a human being gives as valuable and as much excreta as a sheep, the manure of two human beings would be per acre equal to what the farmer now receives from his animals on the farm. On that principle, the population of London would manure a very large area; but I do not think the expense of conveying that manure mixed with water would enable it to pay. I value the sewage of London at £2,000,000 and upwards; and I found this estimate on the principle that the value of the manure from animals and from human beings bears a due relation to the quality, kind, and quantity of the food consumed. This principle is recognized by farmers generally; and I think an explanation of it has been afforded by eminent chemists, who have analyzed food of every description. If a farmer gives a certain kind of food to a certain number of animals, he can judge of the quality of the manure he will obtain. Mr. Lawes has prepared a table giving the estimated value of the manure obtained from the consumption of one ton of different articles of food, each supposed to be of good quality. In round numbers, it shows that the value of a ton of food converted into manure would give 60 per cent. of the cost in some cases; in others, 40 or 30; and in none less than 10 per cent. Applying that principle to the population of London, and taking their consumption of food at not less than £24,000,000 sterling annually, then, upon the low estimate that the manure is worth 1/10th of the cost of the food, we have £2,400,000 as its total value. To this must be added the excrements from 60,000 or 70,000 horses. Corn merchants inform me that 30,000 quarters of oats are weekly consumed in London; and hay in proportion. There are numerous other sources of manure, in the slaughter-houses, manufactories, gas-works, hide, skin, and cattle markets, &c.; but, making every allowance for excreta which does not reach the sewers, I cannot reduce the value of London sewage below £2,000,000 a year. As a farmer, it would be worth as much to me, depending upon the price at which it was delivered to me on my farm. The cost of carriage would be a financial one to the persons engaged in its application. I would give 2d. per ton for London sewage on the ordinary days, placed on my farm. My own costs me 1d. per ton, and I pay a considerable sum to produce it. The average distance I take it from the tank is not more than half or three-quarters of a mile. The average product of grass-land in the kingdom may be taken at 5 tons of green grass per acre, or 1¼ ton of hay. I am convinced, from my experience of sewage, that, according to the quantity applied, that quantity of hay or grass could be doubled, trebled, quadrupled, and quintupled—in fact, much more than that. The system of great crops on a limited area would necessitate a much larger investment on the part of the farmer than would be necessary in proportion on a larger area. I know that the introduction of guano in the hop districts of Kent has induced the farmers—on account of its great portability—to give up heavy manures. I should, therefore, conclude that the mere value of manure on the spot on which it is raised could not be taken as the test of its value on the spot where applied, without adding to it the cost of carriage, &c. I found my opinion, that the London sewage would be exceedingly profitable to land at considerable distance upon this data. You are aware that the water supply of Glasgow is brought from Loch Katrine, with a considerable fall—a quantity of not less than 30 million gallons daily—through a 4-feet glazed pipe. Now, that is one-third of the whole water supply of London on the hottest day. In applying sewage, I would go as far with rye-grass as 2000 tons per acre, which would cost £16. 15s.; and I think that would increase the crop by about 24 tons of grass or 6 tons of hay, which, at £4 per ton, would be worth £24. It would not be safe to calculate upon making this large quantity into hay, unless on separate ground. The calculation of the proportion of hay to grass is 1 to 4—not quite that. Professor Way says that 25 per cent. of green grass is dry matter; but, as hay contains 10 or 15 per cent. of water, it yields more than one-fourth of the green crop. It would depend upon circumstances whether I should continue the application of so large a quantity of sewage for any number of days. I would certainly prefer to waste labour on the part of the men, and have a longer time to put it on, so as to allow it gradually to mix with the soil. It would be a question as to how it would pay me best—whether I should apply it to any large portion of my land—whether I should continue to make meat and manure, or whether I should occasionally break up the land, and grow exhausting crops, such as mangel-wurzel, &c.; for my experience of either natural or artificial grasses, even with my moderate dressing, is, that you can take liberties with that field afterwards. In some instances, I have had six exhausting crops in succession, after two years dressing—viz., two of barley, two of wheat, one of seed-tares, and one of seed-clover. It is a question I have never gone into as to how many tons a year I apply to my farm, and now many tons per acre it is applied over. I apply all the sewage I get on the farm, and I wash guano in it, for dressing the land. I should not propose to apply 20,000 tons per acre over 20 acres of land, because I believe the manure resulting from those extraordinary crops would enable me to dress a very large area on other portions of the farm. If I produce six times as much food as I do now, it would give me six times as much manure as I now have. One thing is quite certain—that at present the farmer does not put on his land more than the produce of one acre.

By Colonel FANE: About three-fourths of my farm is yellow plastic clay, very bird-lime like in wet weather, and like cast iron in summer. My observation shows me that the growth of grasses is more rapid on light soils than on heavy. The heavy soils take most care of the manure, but, rye-grass always grows quicker on the light soils, from the facility with which the roots can search the ground. There is no difficulty in keeping the ground clean with sewage manure.

By Mr. GREGSON: London could not obtain the £2,000,000 a year which I gave as the money value of the sewage, because the cost of putting it on the land would be quite 1d. per ton at a distance. It is only so far valuable if the parties would pay the money for it; in the same way that the waters of Loch Katrine are made available forty miles off. I should make the sewage of London available as far as it was found profitable to carry the principle out. I consider it a great injustice to agriculture, that, having been robbed of 6 million acres to feed the population of London, the sewage should be returned upon a very small area of land. I believe that all the evidence of scientific and practical men has shown that every attempt to solidify sewage is a failure.

By Mr. ADDERLEY: One reason why the sewage of London is so valuable, is on account of the enormous quantity of granulated alkali which is obtained from the trituration of the streets. The phosphates of ammonia in guano are much greater than in sewage; but guano is deficient in alkalies and other things. In taking 2d. per ton as the value of the latter, I adopt the former as a basis. You never could produce exhaustion by dressing land with London sewage, but you would by putting on guano alone, because it is deficient in some of the elements necessary for the growth of plants. The manurial value of a ton of wheat is only about one-fourth that of the ordinary cotton-seed cake. A ton of wheat is worth as food £15, but, as manure, only £1. 13s.; cotton-seed cake, which is worth £9 as food, is worth as manure £6. 10s.; while the manure from a similar quantity of beans is worth £3. 12s. 6d. These are important facts bearing upon the use of food. I arrive at the value of London sewage in this way—I would say in London, you are consuming large quantities of wheat and every other imaginable production, except oil-cake and other cattle food, and I take the lowest calculation of the manurial products of this food. We feed our animals highly with rape-cake, but, I would much prefer human excrement to their manure. The manure used at my farm is nine-tenths farm-yard manure.

Mr. ADDERLEY: Then, how far can the experiments you have been telling us of, guide us as to the effect of town-sewage, which would correspond more with the remaining tenth-part?

Witness: I should say, generally, that whether you fold a number of human beings or sheep, the result would be the same, except that you would expect the greater manurial results from the latter. I think much depends upon the meat which is eaten. So much so is this the case, that a farmer at Ipswich, who clears out the privies there, says he finds that when he goes to the grammar school for manure, it is infinitely more powerful in result than what he obtains from the cottagers, who are less highly fed than the boys at school. I have been told that in the Protestant cantons, the manure is much more valuable than in the Catholic.

The CHAIRMAN: I presume the manure in the City, after Nov. 9, is very rich?

Witness: Very rich. It is well known amongst farmers, that according to the food they give to their animals so are the manurial results, and that is the reason they prefer rich oil-cakes.

By Mr. ADDERLEY: I believe the farmers in England, generally, do not believe in the value of town-sewage. Twelve 13ths in weight of the manure of their sheep and bullocks are liquids, and it is a curious fact that there is more solid manure in the liquid, when dried, than in the solid excreta. By the mode of treating sewage at Birmingham, by passing it through a succession of tanks, no doubt the overflow is more valuable than the deposit. The latter has a value, but it is small, and from the cost of carriage it would not pay to take it far away. A neighbour of mine has just given £5 per acre for 300 acres of land at Croydon, on account of its being irrigated with the clarified sewage of the town. I have heard that liquid sewage has been used to the extent of 8000 tons per acre, but, I do not think it can be done without nuisance to the neighbourhood. After one year's dressing with that large quantity, the land would not be exhausted for many years. It is only with Italian rye-grass you could use such a quantity. I believe that 200 or 300 tons an acre would constitute a very excellent dressing for cereal crops. I have applied 4800 tons in that way. I know cases where the rental of land has been largely increased by water irrigation alone. On the coast of Essex, refuse from London is conveyed by water-carriage a distance of 50, 60, or 100 miles, and paid for by the farmers at something like £20 per 100 tons.

By Mr. BRISTOWE: I should say that from 1000 to 2000 tons of London sewage per acre might be used on drained land without creating a nuisance, if used before decomposition commences. The offensive smell from our tank arises from the manure remaining there some time. I have calculated that the value of town-sewage, upon the average consumption of food by each person, is worth 16s. per head of the population, less something deducted for any little waste.

By Mr. CAIRD: The system adopted at Croydon is that of open irrigation.

By the CHAIRMAN: I consider that, in justice to the land, and having regard to the sanitary condition of the people, the sewage of London, which is derived from the consumption of the produce of 6 million acres, should not go on a less area than 400,000 or 500,000 acres of land.

Professor *Voelcker*, examined by the CHAIRMAN.

I am consulting chemist to the Royal Agricultural Society, and, as such, have given attention to the subject of the supply of manure to this county. The annual amount paid by farmers for foreign and manufactured manures is very large; I do not know the precise money expended. I think it would be useful if the sewage of towns could be utilized for agricultural purposes. I have made analyses of town-sewage, and found that it contains all the fertilizing elements which are usually contained in manurial substances, and which are required for the growth of plants. My attention has been called to the kind of soil upon which the sewage of towns should be applied, From experience and extended observation in various parts of this country, and distant lands, where the liquid manuring system has been generally adopted by farmers, my opinion is, that it may be applied with great advantage on light porous soils, and all soils resembling more or less such land, but that on heavy clay lands, which in dry weather are subject to large cracks, through which the liquid manure will necessarily flow, it cannot be applied with advantage. With more or less disadvantage, especially when highly diluted, it will be of use on almost all soils in a high state of cultivation; but, even when more concentrated than sewage generally is, on heavy clay lands it will create a loss to the person who applies it. It would not be so difficult and unprofitable to apply dry manures to heavy soils, because these have a mechanical as well as a chemical effect, even though poor, which keeps the land lighter, and, by degrees, improves the condition of the soil. I have made a great many experiments upon the capability of different soils to absorb ammonia. All soils have, more or less, the power of absorbing the valuable constituents of manurial matters. Light sandy soils possess that power, but not to the same extent. I have had some experience with regard to tank deposits. The solid deposits are generally not worth the trouble of applying at any distance. I believe it would be very desirable if the urine of human beings could be secured, because the urea changes into ammonia, and because the liquid elements of sewage are always more valuable than the solid. The urine, I believe, contains 6-7ths of the fertilizing matter that passes through in the whole of the year; hence, it is much more important than the solid excrement. I have visited Mr. Mechi's farm. Some of his land I would not apply liquid manure to, as the soil resembles that which I have spoken of, where the manure passes off through the chinks.

By Mr. GREGSON: I consider sewage manure is particularly applicable to grass-land. In dry districts, and upon light soils, perhaps it might be used for green crops, but by no means for all kinds. The same ingredients would be as valuable in dry as in liquid manure, because by rain they would become soluble. I believe that theoretical calculations have no practical bearing in this matter, and that results are thus sometimes arrived at which are contradicted by experience. The intrinsic value of liquid manure, so far as it is dependent upon certain saline matters, is great—perhaps not less, taking the average composition of the manures of different towns, than 2d. per ton—but the practical value is regulated by so many circumstances, that in one place, where, for instance, there are light soils, you could dispose of a large quantity of grass cut green for the use of cowkeepers; in another locality, where there is no grass-land, and you would be obliged to make the grass into hay, there are practical difficulties which make it not so valuable, and hardly worth the trouble of applying it. If we could get the manurial matters out of the sewage in a solid state, they would be worth 2d. per ton; but, diluted with so much water as they are in many instances, the value is reduced to nothing. Upon the average, there are 80 grains of solid manure in a gallon of sewage.

By Mr. CAIRD: I adopt Peruvian guano as the standard of value. A ton of guano is worth £13. 10s. The solid matter in a ton of sewage is 41 ounces, which is worth 2d.; that is, supposing it were extracted, and in the same condition as guano. Fifteen hundred tons of sewage at 2d. would not produce the same effect as 4 cwt. of guano at £13. 10s. a ton; nothing like it, because the valuable portion is mixed up with so much water. As compared with sewage, the ordinary farm-yard manure is four times as strong. The economical application of London sewage would be to the flat lands down the Thames. I am aware that many of those lands are very strong clay, and are very unsuitable to its application.

By Mr. PAGET: The tendency of clay lands to crack is lessened by drainage. I cannot say that, by the frequent application of sewage, that tendency would be prevented altogether.

By Mr. ADDERLEY: The ammonia in sewage manure is worth £60 per ton, the phosphates £9, and the potash £40. I have no statement by me showing the proportion of these ingredients in 100 tons.

By Mr. AYRTON: In my opinion, the only way to arrive at a practical solution of the value of sewage is to see what it will produce. We assume in all the calculations in which a given quantity of manure is put upon the land, that it is in the same condition as the droppings of the sheep are. In manuring with farm-yard manure, or guano or sheep-droppings, we manure in reality only a very small portion of the soil: we put the manure where we like, and where we know from experience it is of use: but, in applying liquid manure we cannot do so; it goes upon the whole of the land, and, in order to produce an effect, we must increase the quantity to a very large extent. By applying a limited quantity of the liquid, you imbue a large extent of soil with only a very small number of grains of fertilizing matter. If you could collect that small quantity, and apply it as a top dressing, you would produce a good effect upon the crop, but being washed into the soil unless used in large quantities, it produces no effect. For this reason I am a strong advocate, on theoretical grounds, for the application of large quantities of liquid manure. When we apply a large mass, say 7000 or 8000 tons per acre to a soil that is naturally porous and deep, we incorporate a large body of earth with a considerable amount of fertilizing matter. By using such large doses upon grass-crops grown on poor soil, we, by degrees, get these solid manuring matters disseminated within reach of the roots of the plant. The evaporation which takes place from the leaves of pasture is very considerable; moisture from a great depth is drawn up, and with it all the solid matters which come within reach; and then we see a marked effect upon vegetation, which will explain why 400 or 500 tons applied to grass-land lead to no practical results, while large quantities, such as 8000 or 9000 tons (and I am not sure whether much larger quantities may not be used with advantage, but that can only be determined by experiment) produce good crops.

By Mr. PAGET: I have seen the results of the application of town-sewage at Cirencester.

By the CHAIRMAN: There is a power in the earth to absorb the peculiar qualities of manures, but that power has its limit. When the liquid manure is too weak, even a clay soil will not remove from it the same quantity in proportion of ammonia and other fertilizing matters that it will do from a more concentrated solution. These matters, after being absorbed, may be removed by large quantities of water. I think sewage should be applied to the land in a clear state, without sediment. I have not formed an opinion whether it should be administered by open irrigation, or by pipes and hydrants. In a sanitary point of view, the latter would be better. At Carlisle, Edinburgh, Croydon, and Rugby, it is open irrigation.

By Mr. AYRTON: Practically, the sewage would not be chemically altered if it ran for ten miles in an open channel. It does not so much depend upon the quantity of soil through which the sewage passes as upon the state of dilution or concentration of the sewage, whether the whole of the manurial substances in it are absorbed. A depth of six inches of soil would be sufficient completely to deodorize the sewage applied to the extent of 7000 or 8000 tons per acre.

By Mr. ADDERLEY: The deposit, if allowed to pass over grass-land, is injurious, because it closes up the pores of the plants, and thus prevents them taking up atmospheric food, although such deposit might be a valuable fertilizer, if incorporated in the soil. The deposit would not be sufficiently valuable to pay for being carted above 3 miles. Supposing the soil, in both cases, to be the same in character, I should be surprised at the result stated by Lord Essex to have taken place upon his wheat crops by the application of 270 tons of poor sewage. It may be explained, to a certain extent, if it were applied in small quantities at a time. I have obtained quite as great a result by the application of 1 cwt. of nitrate of soda.

By Lord HOLMESDALE: I am acquainted with every plan for extracting

dry manure from sewage. There is not the least hope of any of them succeeding; they have all been complete failures.

By Mr. BLENCOWE: It is very difficult to draw any conclusion from a single experiment, as there are so many circumstances which may affect the result. It is only by a long and extended series of experiments that we can hope to arrive at a solution of the question.

(*To be continued.*)

Legal Intelligence.

WESTMINSTER POLICE-COURT.

WEDNESDAY, APRIL 2.

(*Before* Mr. PAYNTER.)

ALLEGED DISCHARGE OF GAS REFUSE INTO THE THAMES.

The Chartered Gas Company appeared to answer a summons taken out at the instance of the Thames Conservancy Commissioners for allowing offensive matter to run into the river from their works at Westminster, contrary to the Statute.

Mr. SLEIGH appeared in support of the complaint, and Mr. MORGAN on behalf of the Gas Company.

Mr. SLEIGH called the attention of the magistrate to the words of the Act under which the summons had been taken out (the Thames Conservancy Act, sec. 102), stated the facts as afterwards proved in evidence, and observed that the nuisance complained of was not only highly prejudicial to health, but destroyed both animal and vegetable life in the river; it was, therefore, absolutely necessary that some steps should be taken in the matter, and he need hardly say that the Thames Conservancy had come forward and taken the matter up purely from public motives.

The following evidence was then given in support of the charge:—

Elisha Trotter, a carpenter, said that, on the 26th of February, he was upon the river at Millbank, fronting the gas company's wharf, when he smelt a very disagreeable odour at a distance of upwards of 100 yards from him. He then perceived something running from a drain at the wharf, and, on dipping his finger into it and smelling it, he found it to be gas refuse. It was proceeding from a brick drain, which had an iron grating in front of it nine inches across, and the discharge formed a gutter in the mud on the shore. On the same day, he collected some in a bucket, afterwards putting it into a bottle, which he handed over to Mr. Lord, the superintendent of the Conservancy Works. He also collected some on the 12th and 15th of March, and calculated that the matter was running at the rate of a gallon per minute. It smelt very offensive, and strongly impregnated the air. There was a pipe affixed to the drain, and some barges moored close to it for the purpose of removing the offensive matter.

Mr. *Richard Lord*, superintendent of the Conservancy Works, identified a number of bottles produced as those handed over to him by the last witness. In his capacity as superintendent, he examined the gas company's wharf on the 8th of March, and found there a tidal trap, with liquor running from it at the rate of half a gallon a minute, which was decidedly gas refuse. It had formed a basin, into which it flowed, and polluted the water and air around. On the 19th of March, he probed the pipe with an iron rod. He put the rod 64 feet up, when it would go no further, owing to some obstruction. From where the obstruction took place was in a direct line with the company's works. Ten feet above the drain, was a pipe from which the liquor was discharged into the barges.

Mr. *F. J. Evans*, engineer and manager of the defendants works, was called by Mr. Sleigh to prove that the wharf in question was their property, and in direct communication with their works. In cross-examination by Mr. MORGAN (after putting in a plan of the wharf, with the drain spoken of, and the pipe above it), he said the refuse from their pipe was shut off by a stop-cock and valve, and, unless the pipe was broken, the liquor could not run into the brick drain, and this could not be, or the leakage would be still going on. The company sold this gas-liquor; it was, therefore, to their interest to save it, and not let it run into the river. The contractor was bound to take it away, which was done by affixing a hose to the pipe, and running it off into barges. They discovered a small leakage on the 12th, and sent down at once, and had the pipe repaired, but he did not believe that a gallon of liquor had run away altogether. The leakage was extremely small, and, as a company, they took every possible care that no offensive matter should flow into the river.

Dr. *Letheby*, medical officer of health for the City of London, said all the bottles which he produced contained a liquid which had been given him by Mr. Lord, and was gas refuse. He found the matter in all of them to be strongly charged with sulphuretted hydrogen and sulphocyanide of ammonia, which were the especial constituents of gas-water. The matter contained ammonia to the extent of 68 grains to the gallon, the bulk of all the samples produced being ammoniacal liquor. One sample was of a very dangerous nature, containing no less than 203 grains of ammonia to the gallon. The liquid produced was of a noxious nature, and detrimental to both animal and vegetable life, and the atmosphere impregnated by the effluvia would be very unwholesome. This refuse matter, with a strong solution of ammonia, was valuable, as it could be sold; but it often occurred that gas companies could not sell it, and they must get rid of it in some way. He had known them obliged to evaporate it under the retorts.

Cross-examined by Mr. MORGAN: Common sewage was detrimental to health, but the fluid he had examined was very greatly so. The bulk of the matter in the bottles was what was termed gas refuse.

Mr. SLEIGH remarked that, by the 166th section of the Act, sewage was permitted to run into the Thames.

William Pearce, a fisherman, at Strand-on-the-Green, in the employ of the Conservancy, gave similar evidence to that already detailed. The liquor, when he first saw it, was running from a hole in the wall, at the rate of five gallons per minute along the shore. A barge, standing near, prevented him seeing distinctly from where it ran, but he saw it twice afterwards running from the drain. It was not running into a barge.

Cross-examined: There was a hose on the wharf above, discharging liquid matter into the barge.

Mr. *William Gardener*, clerk of the works under the Metropolitan Board of Works, also gave simiar evidence. He saw refuse running from the drain on the 8th of March, at a time when there was no barge near it. He saw liquor running again on the 19th, but it was at that time mixed with sewage.

Mr. EVANS said the liquid might have run from the pipe above into the drain at the time of discharge into the barge, and Mr. PAYNTER concurred in this view of the matter.

Mr. SLEIGH remarked that, presuming such to be the case, no matter how the liquid got into the Thames, the company were equally liable.

Mr. PAYNTER did not think such was the law.

Mr. SLEIGH observed, that Dr. Letheby had informed him that in a trial before the Lord Chief Baron Pollock, in the Court of Exchequer, where the Staffordshire Gaslight Company were the defendants, it had been held so, although the nuisance should be caused by others, and not by the gas company.

This was the case for the prosecution.

Mr. MORGAN, in reply to the summons, contended that, under this Act of Parliament, there must be absolute knowledge shown to procure a conviction. The company he represented had no interest in allowing this refuse matter, as it was called, to run away; in fact, the contrary was the case, as it was of some value to them. He urged that there must be some mistake among the witnesses, and that instead of the liquid running out in the manner described, it had simply trickled down the wall from the pipe while being discharged into the barge. Moreover, if the company had had a desire to let this matter run into the Thames, they would not select a time when everyone could notice it—viz., low water. He concluded by complaining of the manner in which such a body as the Thames Conservancy had got up this case, the offence imputed to his clients depending upon the testimony of labouring men, who might have tampered with the samples before giving them to their employers.

Mr. *Henry Bannister*, deputy-superintendent of the company's works, said he received an intimation that there was a leakage on the 13th of March, and men were at once sent down to attend to it. There was no communication whatever between the liquor-pipe and drain. This he knew of his own knowledge, as he had superintended the laying down of the liquor-pipe. In doing so, the workmen had not come in contact with the drain-pipe. Sewage only flowed through it, and it had no connexion with their works. The liquor-pipe conveyed the whole of their gas-liquor away to the wharf, whence it was discharged into barges. This gas-liquor was a very valuable commodity, and they sold it; it was not, therefore, to their interest to let it run into the Thames, as that was so much loss to them.

Cross-examined: The drain communicates in no way with our works.

Mr. *Thomas Barkworth* said he resided at the wharf, and looked after the pipe there; he saw a slight leakage, and communicated with the works, when it was set right. The leakage could not have existed any length of time.

Mr. SLEIGH, having replied,

Mr. PAYNTER observed that he must take time to consider his judgment, and adjourned the case for that purpose.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

CITY COURT OF SEWERS, GUILDHALL, TUESDAY, APRIL 1.

At the Meeting of the Commissioners held this day—Mr. DE JERSEY in the chair,

Mr. HAYWOOD, the engineer, said he thought it his duty to mention to the court that the Carburating Gas Company had not yet completed their contract with reference to the public lamps, the whole number of carburators not having been fixed, and many of those put up not being filled with naphtha. The work was proceeding very slowly, and, he understood, some difficulty had arisen in the performance of the contract, which had caused the delay. Dr. Abraham said he had received a letter from Mr. Shepard, the managing director of the Carburating Company, in reference to this matter, in which he stated that the contract entered into with the commission was not signed until the 24th of January, and they had since used their best exertions to have the carburators fitted up as soon as possible; but they met with difficulties, as they found many hundreds of the side street-lamps required new copper tubing; and, with the standard lamps they were obliged, in many instances, to cut the stand-pipes, and, after fitting up about 300 of them, they received a notice from the gas company that they must put taps under the carburators, in addition to those they had already fitted. This, in many instances, they found impossible, as there was no room between the lamp and its support. They had fitted up above 1200 carburators in the district allotted to them, but they had filled only about 1000 where the 3-feet burners were applied. All those filled were side lamps. These, he stated, were a few of the obstacles the company had to contend with; and the writer concluded by asking Dr. Abraham to make the causes known to the court. Accompanying the letter was a copy of a report recently made to the Holborn District Board of Works by their surveyor, Mr. Isaacs, in which he stated that, after testing the carburetting process, he was enabled to confirm the result arrived at by previous experiments in the City and elsewhere, that a gross saving of 50 per cent. could be effected by the process. The engineer to the Chartered Gas Company had placed at his disposal the photometric apparatus at the works in the Horseferry Road station, and kindly conducted a series of experiments in his presence. These experiments conclusively established the fact that the addition of the naphtha augmented the illuminating power of the gas in a two-fold degree; and that, when heat was applied to prevent the condensation of the evaporated naphtha, the luminosity of the flame was increased trebly; taking the gas as ordinarily supplied as equal to 12 sperm candles, the addition of the naphtha raised the illuminating power to 24 candles, by the modification of the shape of the vessel, and the mode of fixing the same. Mr. Isaacs further stated in his report that the total cost of the public lamps where this process was applied would be £3. 19s. 6d. each per annum, as against £5s. 9s. 6d.; in other words, a saving would be effected of £1. 10s. per lamp per annum.

Dr. ABRAHAM said he thought some notice ought to be taken of this matter, as it was one that deeply affected the commission, as well as the citizens generally. They felt naturally much surprised that the process had not been more generally brought into operation, but it seemed that the company had had many difficulties to contend with, and these they had been unable to get over. He thought the Carburating Company should not have any stigma cast upon them, as it seemed that they had attempted to do their best to carry out their contract. He might mention to the commission that the public were not suffering at all in their pockets by reason of the existing state of things. Indeed, should a larger consumption than 5 feet per hour take place, the company agreed to pay the excess themselves. He thought the report of Mr. Isaacs was a most important one. Already the Carburating Company had contracted to supply carburators to certain lamps in the Holborn district, only consuming 2½ feet of gas per hour, and the light given was equal to a consumption of 5 cubic feet of gas per hour. He thought there could be no doubt that this might also be carried out in the City.

On the motion of Mr. H. L. TAYLOR, the subject was referred to the General Purposes Committee to examine into and report.

SOUTH METROPOLITAN GASLIGHT AND COKE COMPANY.

The Ordinary Half-Yearly Meeting of Shareholders was held at the London Tavern, on Tuesday, April 1—T. B. SIMPSON, Esq., in the chair.

The SECRETARY (Mr. Livesey) read the notice convening the present, and the minutes of the last meeting, and the seal of the company was affixed to the register of proprietors.

The following report and statements of account were then submitted:—

At the last half-yearly meeting of the proprietors, the directors reported that it would be necessary, in the course of the present year, to erect an additional retort-house and chimney-shaft. They also stated that they were then building a large tank; this has been recently completed satisfactorily, and the contractor for the gasholder has already commenced that part of the contract. The new retort-house is also in hand, and the chimney-shaft will be built before the end of the summer. In addition to these extensive works, the directors consider it will be advisable to put up another coal-lift, and to make some considerable alterations in the mains supplying the district.

The two calls of 30s. each, which were made on the shares of the company before the end of last year, are all paid with one exception; and the call of 20s., due the early part of last month, is also nearly all paid. Since then, it has been thought necessary to make another call of 30s. per share; and the directors avail themselves of this opportunity to inform the proprietors that, in all probability, they will require the remaining amount of £6. 10s. per share, to be paid up by instalments of 30s. per share, at intervals of two months.

By the accounts to be submitted to this meeting, it will be seen that the rental for gas, and receipts for products, &c., for the half year ended December 31 last, amount to £37,826. 10s. 6d., and the expenditure for the same period to £27,936. 17s. 9d., leaving a balance of £9889. 12s. 9d. to be appropriated at this meeting; and the directors recommend that a dividend, at the rate of 5 per cent. for the half year, be now declared, which, with the sum required to complete the reserve-fund of £20,000, will nearly absorb the whole amount.

The directors, in the early part of last year, informed the proprietors that they had reduced the price of gas 4d. per 1000 feet throughout the company's district; and, since the account, at the reduced price for the year ended December 31 last has been made up, they have, in compliance with the Metropolis Gas Act, made a further reduction of 2d. per 1000 feet.

By the Act of Incorporation, one director and one auditor retire from office at this period, and Thomas Bridge Simpson, Esq., director, and George Coxhead, Esq., auditor, retire accordingly; but, being eligible, they offer themselves for re-election.

Dr. *Working the Establishment, for the Half Year ended Dec.* 31, 1861. *Cr.*

To Gas rental—				By Management—			
Private	£23,330	5	11	Directors	£ 500	0	0
Public	5,546	18	7	Auditors	31	10	0
	£28,877	4	6	Salaries	972	8	10
Rental of meters	40	10	3	Commissions	275	5	4
Residual products—				Rent for offices	372	9	8
Coke	£7,167	14	0	Stationery, and general charges	1,122	18	5
Breeze	182	7	0		£3,274	12	3
Liquor	308	2	0	Manufacture of gas—			
Tar	769	12	11	Coals carbonized	£13,165	9	2
	8,427	14	1	Supervision and labour	5,583	8	9
Sale of old materials	254	13	0	Tools and other implements	105	7	9
Miscellaneous receipts	226	8	8	Purifying	462	1	0
				Repairs and maintenance	1,880	9	8
				Rent and taxes of works	451	19	10
					21,648	16	2
				Distribution—			
				Repairs and maintenance	£ 120	15	5
				Mains	1,197	9	7
				Services	430	15	8
				Meters—restoring and replacing	391	4	0
				Additional	692	13	3
					2,832	17	11
				Bad debts and allowances	180	11	5
				Balance	9,889	12	9
	£37,826	10	6		£37,826	10	6

Dr. *Balances, to Dec.* 31, 1861. *Cr.*

To Capital			£163,525	10	0	By Works	£134,331	3	0
Reserve-fund	£18,216	11	5	Stock—			
Interest	282	15	0	Coals	£7,545	6	9
	18,499	6	5	Products	142	17	10
Investment-fund	£6,187	1	9	Main-pipes	1,153	9	7
Interest	95	18	5	Service-pipes	311	7	1
	6,283	0	2	Meters	1,086	2	0
Revenue account	9,889	12	9	General stores	794	12	9
Unclaimed dividend account	11	8	0		11,033	16	0
Payments in advance	358	17	4	Amount due to the company—			
Sundry creditors	3,250	13	10	For Gas	£19,125	6	10
Meter depreciation account	789	16	9	Products	743	18	5
				Sundries	636	2	1
					20,505	7	4
				Cash at bankers	£4,459	12	1
				Ditto in hand	73	8	8
					4,533	0	9
				Consols for reserve-fund	18,216	11	5
				Ditto for investment-fund	6,187	1	9
				East India debentures	£7,801	5	0
	£202,608	5	3		£202,608	5	3

The CHAIRMAN, in moving the adoption of the report, said: Gentlemen, I congratulate the proprietors at large upon the continued success of the company's operations. We are, as you know, in that position, that we have been obliged to reduce the price of gas, in conformity with the provisions of the Act of Parliament. Probably, the price will remain where it now is for some time to come, and I hope it will. The gasholder referred to in the report has been, as you are aware, a work of considerable difficulty and trouble to us, inasmuch as we have had to contend with a drift of sand which exists in the neighbourhood, and which it has required great care to deal with. I may say that we owe it to our secretary and engineer, Mr. Livesey, that we have been able to surmount that difficulty. He has brought a great deal of intelligence and skill to bear upon the matter. The diligence he displayed, and the sound judgment he brought to the subject, enabled him to give such advice and instruction to the contractor as to benefit us very much indeed, and greatly to facilitate the completion of the tank. We have now only to finish the gasholder, which, I suppose, we shall be able to do during the coming summer months, and then our works will be, for some time, in a most efficient state. There are other things to be done in the course of the year, to which we have called attention in the report, and which will require a portion of the capital we are now asking you to give. Touching upon the question of capital, you are aware that we have made another call of 30s. per share. The directors have always been extremely chary about making a call upon the proprietors, as we have felt that difficulties might arise as to the payment of the dividends upon the increased capital. That time, however, has now passed, and we think we can beneficially employ the remainder of the capital. To call it up will very much increase the value of your concern, and, as money is so extremely cheap, we deem the present a very favourable opportunity for the proprietors to pay, and for the company to receive, this additional sum. We believe that it will give you a remunerative interest, and, therefore, we hope you will see no objection to the course which we recommend. With these few remarks, I beg to move the adoption of the report. I shall be happy to answer any questions you may desire to put relative to the affairs of the company. Our course is so even, that there is really not much to ask your approval of, or to communicate to you on these occasions; but, if anything suggests itself to your minds upon which you desire information, we shall be very happy to hear it, and to offer you any explanation you require.

Mr. HEMMING: We shall have interest next half year, I suppose, upon the capital which may be paid up?

The CHAIRMAN: Yes, no doubt you will. There is one thing I might have stated. It is quite probable that some of the proprietors may desire to pay up the whole amount of their calls at once. If so, we have the power to receive the money, but we can only allow you 5 per cent. upon it, until the calls come due. After that, you will receive interest upon it, as on the other portion of your shares.

The motion was then put and carried unanimously.

Mr. RHODES: As you are now going to give the shareholders the option of paying up the calls at once, would it not be well that the secretary, in sending round the notices, should inform each shareholder what is the amount unpaid upon his shares?

The CHAIRMAN: I think all the proprietors know that the shares are £50 each, and the amount due upon them is the difference between that sum and the calls already paid. But I understand your object to be, that the shareholders should be informed that they may pay up the whole at once, and receive 5 per cent. till the calls come due.

Mr. RHODES: Yes; otherwise, many may not know that they are at liberty to do so. Respecting back dividends, I think you have never paid us any?

Mr. DREW: Oh, yes we have.

The CHAIRMAN: I assure you I could easily call the fact to your mind, if it were worth while to go into it. I am happy to say we have paid you every farthing we can, according to the last Act of Parliament.

Mr. GRAY: I differ from my worthy friend in the chair, for I should be glad to know that we had some back dividends to receive. At the same time, I am very well satisfied, and have great pleasure in expressing my cordial concurrence in the observations which he has addressed to us. It is quite impossible for any company to exhibit a more gratifying state of affairs, and I sincerely trust our present prosperity may continue. We have received an intimation that our worthy friend's term of office has expired, and that he now comes before us for re-election. I have very much pleasure in moving—"That Thomas Bridge Simpson, Esq., be re-elected a director of the company."

Mr. HEMMING: I second the motion most cordially. It is a very great advantage to us to have the benefit of the services of those gentlemen on the direction, who have brought the company into its present state of prosperity.

The motion was cordially adopted.

The CHAIRMAN: Gentlemen, I am much obliged to you for this mark of your confidence, and for having again placed me in the position I have so long had the pleasure to occupy. I will only add, that so far as my abilities go, they will always be at the service of the company.

Mr. GRAY: Gentlemen, I conceive that much of the advantage which the proprietors are now deriving is attributable to the practical officers of the company. And, in alluding to practical officers, it would be unbecoming if I did not give prominence to our excellent secretary and engineer, Mr. Livesey. He is a most efficient and able officer, and I need not remind you that he acts in three or four separate capacities, by which a considerable saving is effected to the company. I am sure you will all agree with me that where such effectual services are rendered, there ought to be an adequate remuneration given. The chairman has alluded to the trouble and anxiety experienced in reference to the gasholder. The success which has attended that work, has in a great measure arisen from the unwearied attention of Mr. Livesey, and from the practical experience he brought to bear upon it. I

am the last person in the world wantonly to squander the money of any company, but I think so efficient an officer, who devotes so much ability and energy to our affairs, as Mr. Livesey does, should be liberally—I do not say profusely—remunerated. I shall, therefore, move—"That an additional £100 a year be given to our secretary and engineer;" and I feel sure the proposal will meet your approbation.

The CHAIRMAN: I assure you the proposal meets the entire approval of the board. We quite appreciate the services of our friend, and believe we have in him a very intelligent, industrious, and active officer, one whom we could ill spare, and therefore I have much pleasure in seconding the motion.

The motion was carried unanimously.

Mr. LIVESEY: Gentlemen, I thank you most sincerely for the liberal and kind way in which you have rewarded my services. I appreciate very highly the commendation of a gentleman like Mr. Gray in a matter of this sort, and I trust, by continuing to attend to the duties of my office, I shall be able still further to promote the interests of the company.

On the motion of Mr. FAULL, seconded by Mr. REILLY, the retiring auditor, Mr. Coxhead, was re-elected.

The CHAIRMAN then proposed the dividend recommended in the report, which was agreed to.

On the motion of Mr. GRAY, a vote of thanks was given to the directors for their services, which, having been acknowledged by the chairman, the proceedings terminated.

METROPOLITAN BOARD OF WORKS.

FRIDAY, MARCH 28.

COSTS OF THE METROPOLIS GAS ACT.

At the usual Weekly Meeting of the Board—Mr. THWAITES in the chair,

The CLERK read the following resolution, which was passed at a meeting of the Board of Works for St. Olave's district, Southwark, held on the 4th of March—"That legal difficulties having occurred in the settlement of the metropolis gas charges by the Metropolitan Board of Works, and questions involving litigation to determine who were the promoters of the Act being likely to arise, this board concurs in the payment by the Metropolitan Board of a sum of £350 (a proportionate part to be deducted from the balance accruing to this board), with a view to avoid such litigation, and to close the long-pending business."

A similar resolution was also read from the vestry of the parish of St. James and St. John, Clerkenwell; from the vestry of St. Pancras; from the Board of Works of the Holborn district; from the Board of Works of the Fulham district; and from the Board of Works of the Greenwich district.

These several resolutions were referred to the Finance Committee.

SALE OF GAS ACTS.

The following report was read from the committee of the whole board on the Sale of Gas Acts:—

Spring Gardens, March 25, 1862.

Your committee have to report, with respect to the piece of land at the corner of Wheeler Street and White Lion Street, Spitalfields, which your honourable board agreed to purchase from the Commissioners of Her Majesty's Works, &c., as a site for the erection of the permanent meter-testing-house for the eastern district of the metropolis, that, in carrying out the arrangement for the purchase, it has been ascertained that the piece of land in question, in consequence of the arrangement of adjoining plots, is 56 feet 3 inches in breadth at the rear, instead of 60 feet, as originally supposed, that being the measurement of the frontage. It being absolutely necessary for the purpose of erecting the meter-house that a rear length of 60 feet should be secured, your committee have ascertained that the additional width of land required may be obtained for the sum of £74. 13s. 4d., being at the same rate as that for the ground already sold to your honourable board; and your committee recommend—"That an additional slip of ground, 4 feet wide, be purchased for the gas-meter-testing-house, at the corner of Wheeler Street and White Lion Street, Spitalfields, at a cost of £74. 13s. 4d."

Your committee beg to state, for the information of your honourable board, that the number of meters tested by your inspectors, from the 9th of November to the 25th of March instant, is 10,000, and the amount of fees received during that period is £325. 4s.

Your committee have also to report that they have had before them an account from Messrs. Parkinson and Co., amounting to £665. 2s. 8d., for work performed by them in fitting up the gasholders and other apparatus at the meter-testing-house in King Street, Covent Garden, and for articles supplied for the use of the inspectors, in testing meters, and they recommend—"That the account of Messrs. Parkinson and Co., for gasholders and fittings at the testing-house, King Street, Covent Garden, amounting to £665. 2s. 8d., be paid."

All which your committee beg to submit.

Mr. HUGHES moved the adoption of this report.

Mr. LEGG asked whether the amount of fees would pay the expenses?

The CHAIRMAN said this was a question which could not be immediately answered.

Mr. ECKETT thought the report, as now presented, an extremely unsatisfactory one. He expected that the number of meters tested at the several stations, with the dates when such testing took place, would have been set forth; but the report merely gave a return of the gross number of the meters tested, and kept the board in ignorance of the names of the stations, and of the parties by whom they were tested. He repeated that it was a most unsatisfactory document, and that he could not concur in the propriety of its presentation. They had a right to know what had been done at the respective stations, by the respective officers, in order that they might be able to compare the general efficiency of those officers in their several localities. The amount of fees received from November to March appeared to him to be very small, and he hoped there would shortly be an increase in the receipts. He did not know whether he should propose an amendment.

The CHAIRMAN said he had sent for the details, which had been laid before the committee.

Mr. ECKETT expressed a wish to have those details printed. He hoped that an abstract of them would, at all events, be presented, for general information.

The CHAIRMAN promised that an abstract of them should be brought up on that day week.

Meanwhile, the report was agreed to.

DR. J. NORTHCOTE VINEN'S REPORT ON THE GAS SUPPLIED BY THE SURREY CONSUMERS COMPANY:—

1862. Week ending.	Number of Observations.	Maximum Light. Candles.	Minimum Light. Candles.	Average Light. Candles.
March 22	4	16·01	12·21	14·35
„ 29	4	15·65	13·29	14·84

These observations were made with a 15-hole argand burner, having larger holes than that previously in use. The volume of hydrocarbons averaged 4 per cent.; carbonic acid, 1 per cent. There was no trace either of sulphuretted hydrogen or of ammonia.

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MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

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B. G. begs to call the attention of Gas Companies to his Fire-Clay Retorts, which have been used with great satisfaction in some of the largest Gas-Works in the Metropolis and many Provincial Towns in England.

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I am, dear Sirs, your obedient servant,
CHARLES THOMAS, Superintendent,
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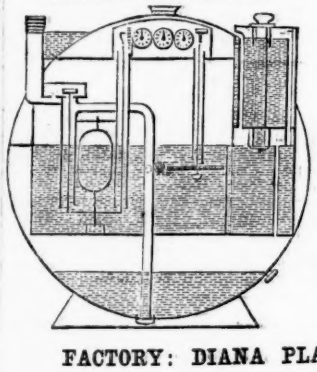

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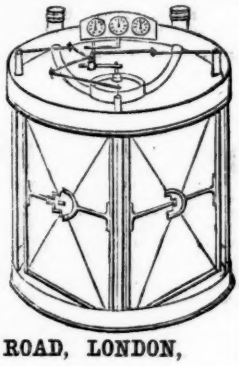

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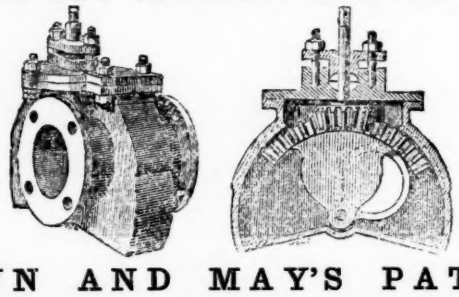

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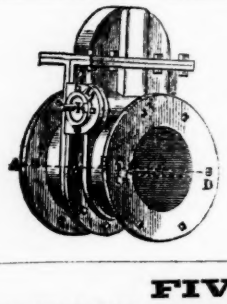

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